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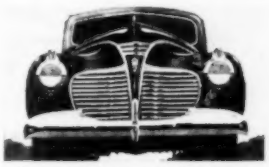

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VOLUME 137—NUMBER 5

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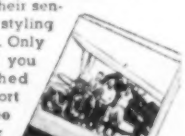

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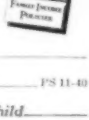

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Amazing rubber mold-making outfit makes perfect flexible molds of plaques, ash trays, book-ends, etc. Molds cost from 6c to 25c each. Each mold makes hundreds of novelties and gifts to sell up to $1.00 apiece! No experience necessary. Quick and easy. Start profitable business in your home . . . sell to stores, gift shops, friends, resorts, road stands, by mail. Full or spare time. "Molders Handy Book" and list of buyers FREE. Write

SO-LO WORKS
Dept. N-823 Cincinnati, Ohio

BUT JIM. I DON'T SEE HOW WE CAN AFFORD TO MARRY ON YOUR LOW PAY
MARY'S RIGHT. I HAVE NO RIGHT TO ASK HER TO MARRY ME ON THE MONEY I'M MAKING.
LOOK HERE. N.R.I. HAS TRAINED HUNDREDS OF MEN LIKE ME TO MAKE GOOD MONEY IN RADIO. I GUESS I'LL GET THAT FREE BOOK
LEARNING RADIO THIS WAY IS ACTUALLY FUN. I'M ALREADY MAKING $5 TO $10 A WEEK IN SPARE TIME. RADIO CERTAINLY OFFERS OPPORTUNITY TO WELL TRAINED TECHNICIANS
YOU CERTAINLY KNOW RADIO. MINE NEVER SOUNDED BETTER.
THANKS. YOU SEE, I HAVE TAKEN N.R.I. TRAINING
OH JIM. IT'S WONDERFUL. NOW YOU'RE ON THE WAY TO SUCCESS
YES MARY, AND THERE'S A REAL FUTURE FOR US IN RADIO AND TELEVISION

I Trained These Men

Chief Operator Broadcasting Station

Before I completed your lessons, I obtained my Radio Broadcast Operator's license and immediately joined Station WMPC where I am now Chief Operator.
HOLLIS F. HAYES
327 Madison St.
Lapeer, Michigan

Service Manager for Four Stores

I was working in a garage when I enrolled with N.R.I. I am now Radio service manager for the M..... Furniture Co. for their four stores.
JAMES E. RYAN
119 Pebble Court
Fall River, Mass.

$10 to $20 a Week in Spare Time

I repaired some Radio sets when I was on my tenth lesson. I really don't see how you can give so much for such a small amount of money. I made $600 in a year and a half, and I have made an average of $10 to $20 a week—just spare time.
JOHN JERRY
1529 Arapahoe St., Room 17,
Denver, Colorado

$200 to $300 a Month in Own Business

For the last two years I have been in business for myself making between $200 to $300 a month. Business has steadily increased. I have N.R.I. to thank for my start in this field.
ARLIE J. FROEHNER
300 W. Texas Ave.
Goose Creek, Texas

I WILL TRAIN YOU AT HOME
in your spare time for a GOOD JOB IN RADIO

J. E. SMITH, President
National Radio Institute
Established 25 years

If you can't see a future in your present job; feel you'll never make much more money, if you're in a seasonal field, subject to lay offs, IT'S TIME NOW to investigate Radio. Trained Radio Technicians make good money, and you don't have to give up your present job or leave home to learn Radio. I train you at home nights in your spare time.

Why Many Radio Technicians Make $30, $40, $50 a Week

Radio broadcasting stations employ operators, technicians. Radio manufacturers employ testers, inspectors, servicemen in good-pay jobs. Radio jobbers, dealers, employ installation and servicemen. Many Radio Technicians open their own Radio sales and repair businesses and make $30, $40, $50 a week. Others hold their regular jobs and make $5 to $10 a week fixing Radios in spare time. Automobile, Police, Aviation, Commercial Radio; Loudspeaker Systems, Electronic Devices are other fields offering opportunities for which N.R.I. gives the required knowledge of Radio. Television promises to open good jobs soon.

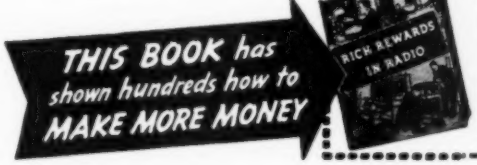
Many Make $5 to $10 a Week Extra in Spare Time While Learning

The day you enroll, I start sending you Extra Money Job Sheets—start showing you how to do Radio repair jobs. Throughout your Course I send plans and directions which have helped many make $5 to $10 a week extra in spare time while learning. I send special Radio equipment to conduct experiments and build circuits. This 50-50 training method makes learning at home interesting, fascinating, practical. YOU ALSO GET A MODERN, PROFESSIONAL ALL-WAVE, ALL-PURPOSE SET SERVICING INSTRUMENT to help you make money fixing Radios while learning and equip you for full time work after you graduate.

Find Out What Radio, Television Offer You—Mail Coupon

Act Today! Mail the coupon for my 64-page book, "Rich Rewards in Radio." It points out Radio's spare time and full time opportunities and those coming in Television; tells about my Course in Radio and Television; shows more than 100 letters from men I have trained, telling what they are doing and earning. Read my money back agreement. MAIL COUPON in an envelope or paste on a penny postcard—NOW!

J. E. Smith, President, Dept. OMP3
National Radio Institute, Washington, D. C.



Mail this to get 64 page book FREE

J. E. Smith, President, Dept. OMP3
National Radio Institute, Washington, D. C.

Mail me FREE, without obligation, your 64-page book "Rich Rewards in Radio." (No salesman will call. Write plainly.)

AGE.....

NAME .....

ADDRESS .....

CITY..... STATE.....

Our Readers Say

Should Plane Windows Be Bigger for Such a Big View?

As an appreciative occasional user of our air lines, I have no complaint against the splendid service they all render. That they are safe to use is attested by the records. That they're fast, no one can dispute. Comfort, service, individual attention at every turn, and, last but not least, a remarkable economy, all combine to make flying just about the most attractive way of getting where you want to go these days. But I do have a bone to pick. The windows on the commercial planes of today are so small that you almost have to break your neck to see out of them. I refuse to be one of those blasé passengers who read a book from the time they take off until they land. Without an apology, I confess that I sit and stare out the windows (?) with the unblushing enthusiasm that a visiting fireman displays for the big city's tall buildings. Something should be done to change those tiny "portholes" into first-class show windows. Maybe some air-line official will explain.—D. S., Montclair, N. J.

He Might Lend It to the Salesman Who Sells Straw Hats to Eskimos

By this time, millions of electric fans in hundreds of thousands of offices and homes have been turned off and put away for another summer. Talk about wasted potential energy! The guy who can think up some way to "put it to work" the year round will really have something. The big electric companies would have something, too, and so would their employees and stockholders, in the way of increased profits from increased sale of electricity. If all the fans in the country were made to turn the year round . . . Oh, well. Who wants to borrow my electric fan for the winter? I don't know where to store it in my one-and-a-half-room apartment.—T. R., Troy, N. Y.

(Continued on page 14)

Don't Jump to Conclusions on That Jumping Brick

Maybe I'm just a killjoy, but I'm afraid that all the work of the mathematician Perrin, mentioned in the letter of A. G. B., of Sacramento, Calif., about the brick that on certain rare occasions might be expected to jump up in the air when its atoms got out of whack, was done in vain. He made his mistake when he got the impression that the atoms move every way at random. It so happens that each atom moves in a straight line until it collides with another atom, then the two bounce off of each other. Therefore, if an atom is moving straight up, there is bound to be one moving straight down. If this were not so, there would always be more atoms moving in one direction than another, and the brick would always be either sliding around or jumping up and down. No doubt, he has noticed that this does not happen. While I am at it, how about a bigger automobile section? We all own cars. Why doesn't Gus Wilson have a "Questions from Auto Owners" column? His articles are tops. He's the guy who got me interested in automobile repairing.—A. J. H., Lynn, Mass.

A bigger automobile section that should interest A. J. H. and countless others who have requested it will be found in this issue and those to follow.—Ed.

A Reader Explains the Exploding Lamp Chimney

In regard to A. B. H.'s exploding lamp chimney, I am not a "reliable glass factory," as he mentions, but I can offer a possible answer to the question of what made the chimney go to pieces. Anyone familiar with chemistry has heard of "Rupert's drops," used for a novel experiment. They can be thrown around and will not break until the surface is scratched or cut. The reason is that they are made with a very thin but tough skin, while inside the glass is under tension or pressure. The lamp chimney was probably under the same strain, and when it cooled—probably irregularly because of a

HOW A BALKY CAR WAS MADE TO RUN SMOOTHLY BY ONE SIMPLE CHANGE

MY CAR HAD THE JITTERS. The motor missed, backfired and bucked like a broncho. It had no power on the hills. I couldn't figure what was wrong until—

A SERVICE MAN PUT ME HEP to Auto-Lite Spark Plugs. "They'll give your car new life," he said. "Those old plugs now waste plenty of gas, that costs you money."

RUNS SMOOTH AS SILK NOW! My motor purrs like a kitten. And say, I've sure cut my gas bills since I put those new Auto-Lite Spark Plugs to work for me.

Is your car spark-weary? Let the Auto-Lite mystery spark give it new life!

YOU'LL be amazed at the difference in the performance of your car when you replace old, gas-wasting spark plugs with sensational new Auto-Lites! Lazy motors suddenly take on new pep, gain lively pickup and smooth, responsive power. Gas wastes are eliminated.

Auto-Lite Spark Plugs deliver an amazing *Mystery Spark* that steps up the efficiency of the entire ignition system. To harness this remarkable ignition spark, Auto-Lite's famous staff of engineers created a new-type electrode, made of a new Konium alloy in a new geometric gap design. They developed a new "Ziramic" insulator and other revolutionary features.

Try this new kind of spark plug in *your* car. Discover for yourself why thousands of car owners coast to coast are switching every week. Remember—Auto-Lites cost no more than ordinary plugs.

ROASTED AT 2000°—Testing insulator resistance at twice temperatures found in average engine operation guarantees Auto-Lite durability. This is one of many exhaustive laboratory tests which safeguard Auto-Lite quality.

THE ELECTRIC AUTO-LITE COMPANY
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Ignition Engineered by Ignition Engineers

Change to AUTO-LITE SPARK PLUGS

Our Readers Say (CONTINUED)

slight draft—the strain became too great at some point and the whole thing went to pieces.—J. A. W., Oberlin, Ohio.

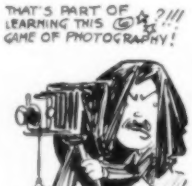
There Are More Ways Than One of Getting Fish out of Water

YESTERDAY I decided to clean out my very heavy tropical fish bowl. Under the heading "Car Tips for Amateur Mechanics," in a recent issue, I noticed that to draw gasoline from the car tank you can use a rubber tube wrapped around and then removed from a clothespin to start the siphon. I decided to try it on my fishbowl, and it worked perfectly. This prevented me from getting dirty and fishy water in my mouth. Thanks lots.—R. W., New York City.

Afraid that R. W. wasted time. The method he used is fine for car gas tanks and other narrow-top containers. But in an open bowl, the easiest way to start a siphon is to submerge the rubber hose until it's full, pinch and withdraw one end, and lower it below the water line.—Ed.

Either You Get a System or You Don't Get Pictures

UNNUMBERED other camera fans are probably writing to sympathize with T. U., of Columbus, Ohio, besides myself. It's no joke to spend hours taking pictures with empty film holders. T. U., what you need is system, and it is something that God didn't give you cheap. You either get a system or you don't get pictures. There are a lot of practical ways, if you want one. You could weigh each film holder before you used it. If it's loaded, it would weigh more. I never tried it, but it should work. You could snap a rubber band around the empties, which should work until Junior wanted to make a model airplane. I still don't think you are in such trouble. You have the films. You have the kid. I'll bet Junior had a runny nose that day, anyway. Maybe he poses better when there isn't any film in the holders. Seriously, did you ever try shooting pictures without film? Say, now, there's an idea. Cheap; soul satisfying; and the kids always pose better under those conditions. Try it some time. Then just to cross the kid up, have, say, three films ready right at the end.—R. V. S., Burlington, Iowa.



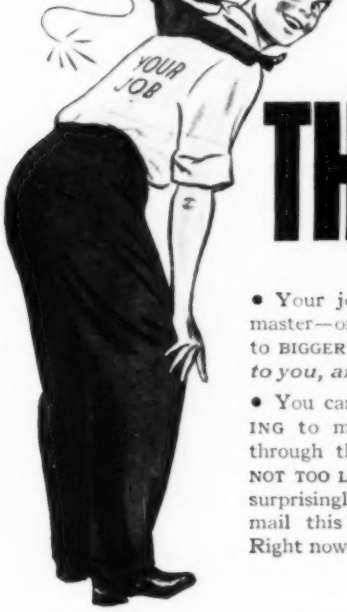
A Slightly Gruesome Math Problem for Budding Generals

YOUR magazine is so darned interesting that once I start to read it I can't put it down until I've read it completely through. Then I have another month with nothing to do but reread the book about ten times over. Your new arrangement is swell and it helps us to look up back articles with very little trouble. Speaking of articles, the one started recently on radio for beginners is tops. And now I have a problem that will amuse you while you're waiting for the second half of some Saturday afternoon football game to come in over the radio, but should leave you time to spare to hear the changes in the line-up. Here it is: After a repulse, a general found that only 5,400 men more than half of his former force were fit for service, as 400 more than one fifth were wounded, and 500 more than one eighth were killed, missing, or prisoners. What was his force before the battle?—A. D. N., Vancouver, B.C., Canada.

What Bothers a Lot of Us Is Making the Darn Stuff Grow

HAVING absorbed an untold number of ideas—screwy and otherwise—from this column, I would like to submit one of my own, leaving it to others to decide which heading it belongs under. The heat of summer makes a man's whiskers grow faster than they do in winter. Supposing you stayed in a place that was air conditioned. Would that retard the growth somewhat? If so, would it be possible to prevent the growth entirely by living in a very cold place? Or, perhaps, kill the growth by suddenly thrusting your face into a cold chamber especially made for the purpose? Such a machine could also be used to rid women of excess hair on their legs, and with certain

(Continued on page 16)



THIS?

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• You can get the TRAINING to master your job through the I. C. S. It's NOT TOO LATE! The cost is surprisingly low. Mark and mail this coupon TODAY! Right now!

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Present Position.....

Canadian residents send coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada. British residents send coupon to I. C. S., 71 Kingsway, London, W. C. 2, England.

Our Readers Say (CONTINUED)

modifications it could take the place of a haircut. As you can see, the possibilities are endless.—J. S., Yonkers, N. Y.

He'll String Along with Mager, Hook, Line, and Sinker!

Was amused at the story about the conversational catfish, on page 127 of your October issue, that "talks" on the radio. When removed from his (?) tank in the Staten Island, N. Y. zoo, the story ran, the fish "made curious sounds into the studio microphone as part of a natural-history program" that was sent out from a New York radio station. Imagine my surprise when I turned over the next page to Gus Mager's "UN-Natural History" and read that "No fish . . . . . has ever acquired vocal organs of any sort." I'm inclined to string along with Mager.—M. R., Buffalo, N. Y.

Mager was right, and so was the fish story, notwithstanding. Croakers, for example, are defined by Webster as "Any of various fishes that produce croaking or grunting noises, as certain grunts and surf fishes." The noises occur when the fishes are out of water.—Ed.

He Wouldn't Worry About That When the Bombs Started Falling

The September issue of P.S.M. was certainly a honey. I want to compliment you on your cover, and on the career of David Sarnoff. I have just looked at "With the Inventors" and "Readers Say." The letter from M. L. Z. about the new invention of the soldiers' helmets that "bounce" the bullets away was very clever. I also noticed the invention of Andre D'Amico, in "With the Inventors," of the house that disappears into the ground as a protection against aerial bombs. What would happen if the concussion of a bomb happened to break the hydraulic plunger, or if tons of dirt covered the roof so that the weight was so great that the plunger couldn't raise it again, or if the metal spread out?—A. C. Z., Valley Stream, N. Y.

This Should Fold Up the Umbrella Problem

The answer to P. M. D.'s problem about the partially open umbrella is 10° 18'. By constructing a triangular pyramid the base of which is at right angles to the center stick of the umbrella, with two of the ribs forming the other sides, it was easily worked out. A line was drawn in the base perpendicular to one side of the base and continued up to the apex to aid in the solution.—J. V., Montrose, S. D.

The Navy's Own Mascot, Complete with Whiskers and Horns!

The Navy certainly was thinking of its football team when it made the aircraft carrier *Lexington* (P.S.M. Sept. '40, p. 42). Your picture of her, at any rate, certainly gives the lifelike impression of the Navy's mascot, the billy goat, complete with whiskers and horns. I wonder if the Army goes around with mules on its tanks?—S. Z., Fairfield, Conn.

Reader Points Out that Almo Was Not a "Seeing Eye" Dog

May I call your attention to an article appearing on page 72 of the September issue of your magazine referring to the first dog brought to this country to guide the blind? Almo was not the first. Lux von La Salle was the first dog brought here from Europe for the purpose, and was trained here in this country at the La Salle Kennels in Minneapolis, Minn., for the late Senator Thomas D. Schall, Almo was a "Master's Eye" dog, and not a "Seeing Eye." The Seeing Eye represents a corporation in New Jersey, while "His Master's Eyes" represents a school in Minneapolis.—G. G., Chicago, Ill.

We're glad to have this case of mistaken identity cleared up.—Ed.

There's Still Quite a Gap; Still, It's Quite a Collection

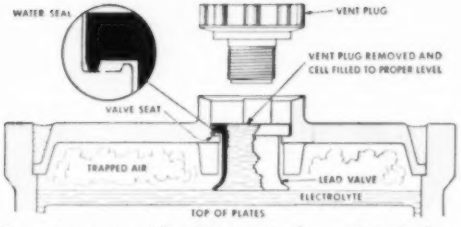
In the last few issues of your magazine, I have become interested in what the readers have to say. I thought maybe it would be of interest to these readers, and perhaps to yourselves, to know that I have kept every issue of your magazine from October 1934 to the present, which will very soon make seventy-two copies, all in perfect condition. I have secured issues of your magazine, moreover, from 1872 to 1874, bound in four volumes.—P. A. H., Minneapolis, Minn.

The New DELCO ELECTRO-LEVEL

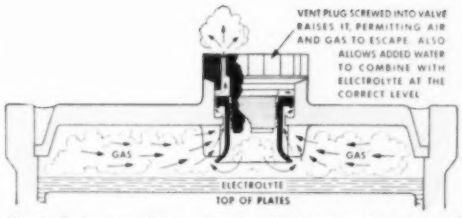
AUTOMATICALLY ELIMINATES OVERFILLING

When the electrolyte level in a battery is too high, acid is sprayed through the vent holes by the pressure inside the cell . . . pressure that is built up by the release of gases when the battery is being charged. This acid spray attacks battery connections and battery carrier. The new Delco battery is protected against these conditions by the Delco Electro-Level, which automatically prevents overfilling when water is added.

HOW THE DELCO ELECTRO-LEVEL WORKS



Vent plug removed for filling—valve forms air lock when electrolyte reaches proper level. Notice particularly the *water seal* formed when the edge of the valve drops into the layer of water retained by the ridge around the valve seat. This layer of water is replenished by condensation, eliminating any possibility of a leak in the air lock when the lead valve is in position for filling.


VENT PLUG SCREWED INTO VALVE RAISES IT, PERMITTING AIR AND GAS TO ESCAPE. ALSO ALLOWS ADDED WATER TO COMBINE WITH ELECTROLYTE AT THE CORRECT LEVEL
GAS
GAS
ELECTROLYTE
TOP OF PLATES

Vent plug screwed in—valve is raised to permit escape of trapped air and gases from the cell through the passage and the vent hole in the plug. Notice here the efficient baffle arrangement through which the gases must pass. This condenses moisture and breaks up the acid spray which might otherwise escape to damage the battery carrier and connections to the battery.

Stop in at your nearest Delco battery dealer's and let him check your present battery on the Battery "Life Expectancy" Chart. He has a Delco battery that is exactly the right size and type for your car.

Delco-Remy

ANDERSON, INDIANA

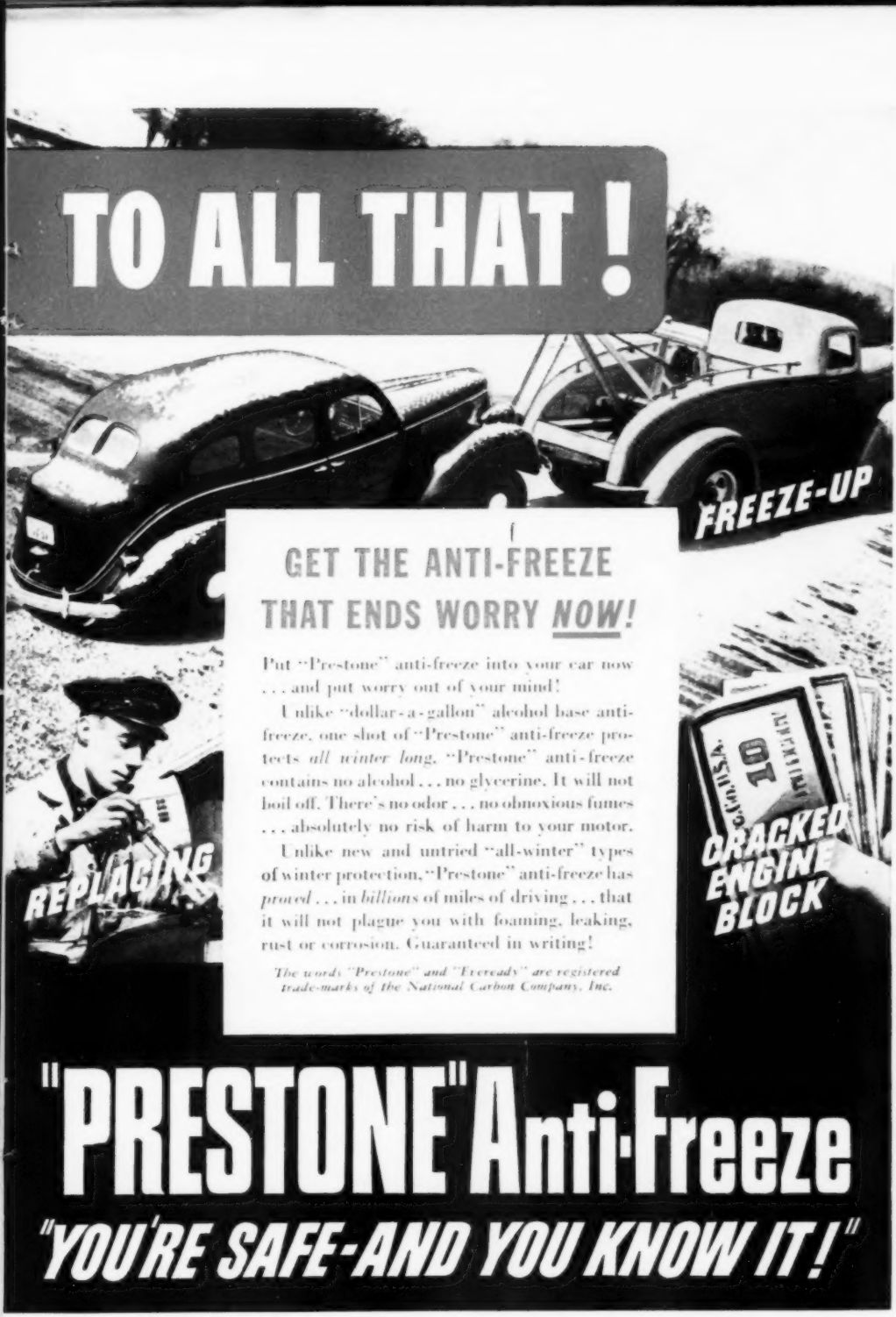
World's Largest Manufacturer of Automotive Electrical Equipment

"PRESTONE" Anti-freeze

is used in more cars than any other brand!

Last winter alone "Prestone" anti-freeze saw motorists through more than 24 billion miles of carefree driving. It's the choice of the U. S. Army, Navy and Marines for protecting vital equipment from freeze-up!

$2.65 PER GALLON



GET THE ANTI-FREEZE THAT ENDS WORRY *NOW!*

Put "Prestone" anti-freeze into your car now . . . and put worry out of your mind!

Unlike "dollar-a-gallon" alcohol base anti-freeze, one shot of "Prestone" anti-freeze protects *all winter long*. "Prestone" anti-freeze contains no alcohol . . . no glycerine. It will not boil off. There's no odor . . . no obnoxious fumes . . . absolutely no risk of harm to your motor.

Unlike new and untried "all-winter" types of winter protection, "Prestone" anti-freeze has *proved* . . . in *billions* of miles of driving . . . that it will not plague you with foaming, leaking, rust or corrosion. Guaranteed in writing!

The words "Prestone" and "Eveready" are registered trade-marks of the National Carbon Company, Inc.

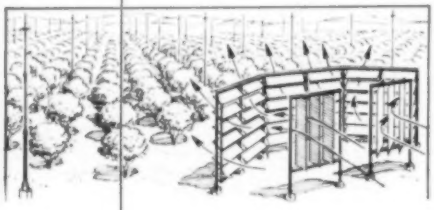
"PRESTONE" Anti-Freeze

"YOU'RE SAFE-AND YOU KNOW IT!"

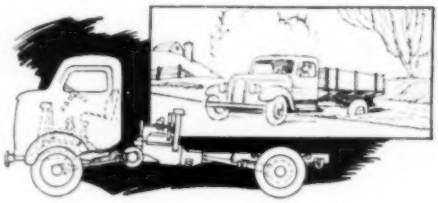
With the Inventors

SKATE from the street right out onto the ice pond. This is literally possible with a pair of double-duty skates invented not long ago by Louis M. Friedmann, of Chicago, Ill. Having roller-skate wheels on one side, and an ice runner on the other, a unit that fits snugly into clamps attached to the foot plate of each of a pair of skates can be quickly reversed, depending on the type of skating you intend to do. Thus the user can put the skates on at home, skate on rollers to the side of a frozen lake, unfasten the reversible roller units, replace them with the runner sides down, and be ready for a whirl on the ice . . .

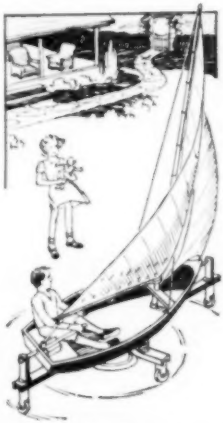
NEARLY ALL so-called "patent-medicines" are not patented at all, but covered instead by registered trade-marks . . . TO PROTECT GROVES OF FRUIT TREES from hot, static-electricity-carrying wind and dust, John Del Rea De Land, Anaheim, Calif., inventor, has devised a system of wind deflectors and static antennas that is said to prevent the burning of foliage common to hot climates. Vertical louvers deflect the wind sideways



against a system of horizontal louvers which force it upward to clear the tops of the trees. Then, to prevent static electricity in the turbulent air and dust from discharging upon and damaging the foliage, vertical antennalike collectors are scattered through the grove to lead the electricity harmlessly to the ground . . . THE INVENTIONS of a deceased inventor may be patented through application by a legal representative of the inventor . . . TWO MOTORS, one in a cab-over-engine set-up, the other just behind the cab, power a truck proposed by Frederick A. Ward, of Highland Park, Mich. The forward engine is connected through a drive shaft to a differential behind it, and thence by more shafting to the front wheels. The rear



engine transmits its power independently in conventional fashion to the rear axle. Either engine or both may be used at the will of the driver. The system is particularly useful for pulling out of ditches and for driving through soft earth, mud, or snow . . . CHANGING THE MATERIAL of which an item is made does not in itself constitute an invention . . . LEARNING TO SAIL A BOAT in the safety of your own back yard is possible with a device developed by Seifert W. Rousseau, of Port Washington, N. Y. The mast, sails, and tiller of a small boat are mounted in their regular way aboard a dummy hull, which is made so that it will tip or "heel" in the wind. The entire assembly can be revolved to port or starboard by means of a reversible motor operated by the tiller. Used in a wind, the device is said to duplicate exactly the response of a real boat to tiller and sail adjustments . . . ALL INVENTIONS are referred to by the Patent Office as "improvements." . . . WITH ITS TUNING DIAL at the level of the eyes of



(Continued on page 22)

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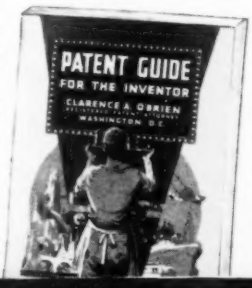

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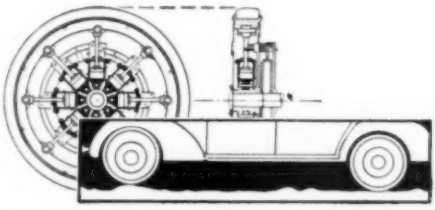
With the Inventors

(Continued from page 20)

an adult standing in front of it, a radio receiver recently patented by Donald V. Marsh, of Lexington, Ill., boasts a number of other novel features. Control knobs, for example, are at waist level for easy manipulation. On each side near the top, lights swing outward at the touch of a button, making the set serve also as a reading lamp. Beneath each light, concealed bookshelves mounted on hinges may be opened out from the cabinet when desired. The inventor points out that the outfit not only serves as a floor lamp, but places the tuning controls above the reach of small children . . . A MODEL OF YOUR INVENTION is rarely required with your patent application . . . CONVENTIONAL AUTOMOBILE SPRINGS might well be eliminated entirely by wheels that contain their own spring mechanism. Such wheels, using cylinders, pistons, and piston rods as spokes, have been perfected and patented by John Bartho, of New York City, and John T. Ackerson, of Radburnfair Lawn, N. J. The inventors point out that heretofore any springing action built into wheels has tended to let power application at the hub turn the hub faster than the rim.



With the present design, however, they claim a positive drive is automatically provided by short plungers that engage the outer end of each piston rod as it passes through a part of its revolution. The plungers, on arms connected to the driving hub, extend and retract as one end slides along

(Continued on page 24)

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With the Inventors

(Continued from page 22)

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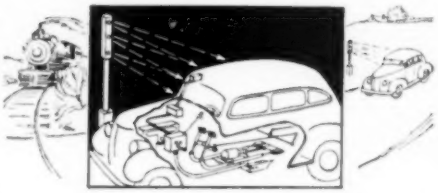
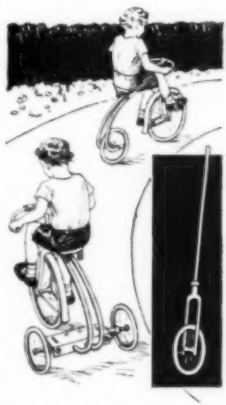


busses halt at railroad grade crossings when a train is coming is the purpose of another automotive invention. An approaching train turns on a set of lights on a roadside post near the tracks. A brilliant fan of light directed across the road strikes a photo-electric cell mounted on the side of any passing vehicle. The cell, through an electrical hook-up, operates a valve which allows the vacuum in the car motor's intake manifold to release the car's clutch and automatically apply the brakes. Arthur W. Cowles, of New Hampton, Iowa, is the inventor of the system . . . A YOUNGSTER'S SCOOTER THAT "grows up" with its owner is the invention recently credited to L. R. Johnson, of Cleveland, Okla. Built as a tricycle, with one wheel and its pedals forward, and a pair of wheels behind, the device is suited to small children. Later, while a child is still too small for a conventional bicycle, the two rear wheels of the tricycle can be removed and one inserted on a short axle in the specially designed rear fork. A small bicycle is the result, just the right size for its owner, and ideal for teaching a youngster the principles of balancing himself on a two-wheel vehicle. The extra wheel can be attached to a broomstick and used as a pushing wheel, or it may be kept as a spare for replacement use.



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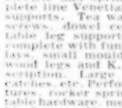

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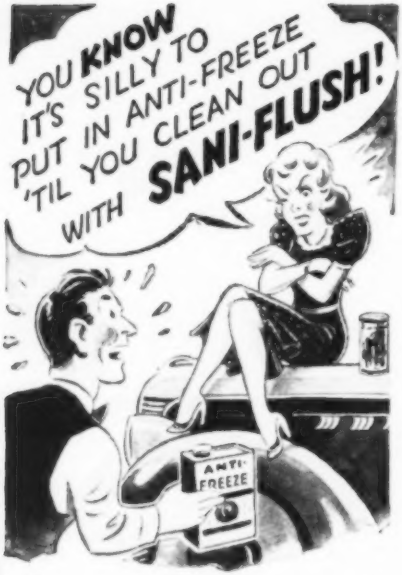

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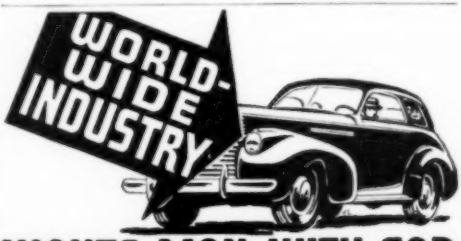

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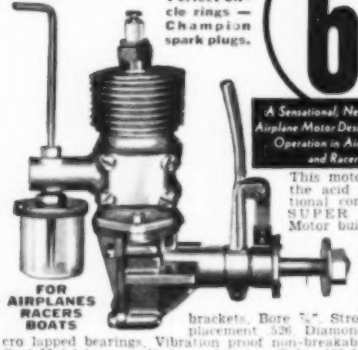

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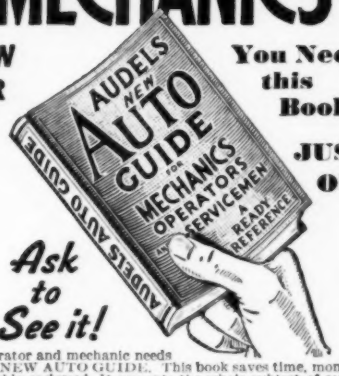

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Furrows on New Plywood Give Weathered Look

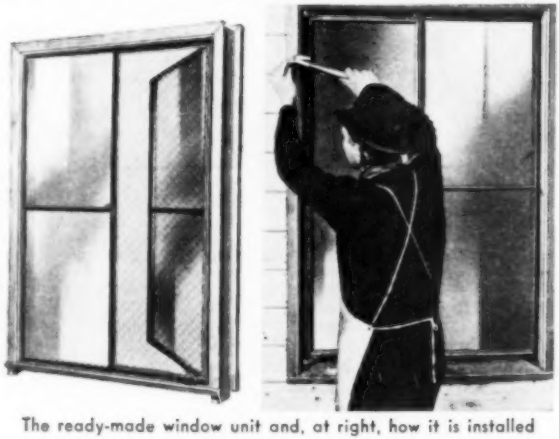
PLYWOOD with a surface which is furrowed to give it the appearance of weathered wood, has been made available by an eastern manufacturer. In addition to its artistic appearance, according to the maker, the new plywood has the advantage that the furrows eliminate the danger of buckling or splitting from expansion or contraction. Two types of the material are available, one for outdoor, the other for indoor use. Nails driven in the furrows do not need countersinking.

Chemical Dries Basement by Absorbing Moisture

HUMIDITY control in basements, photographic darkrooms, home workshops, and other places in the home where too much moisture is likely to produce discomfort and damage, is made easier by flakes of calcium chloride now being marketed in 100-pound moistureproof bags and 400-pound steel drums. The flakes absorb three times their own weight in moisture from humid air to which they are exposed. By reducing the amount of water in the air, the flakes also prevent condensation on metal.

Complete Windows Come in Packages, Ready To Install

WINDOWS in packages, complete with glass and ready to install, are being marketed by a Michigan concern. One workman, using only a hammer and nails, can make an outside installation of one of the new packaged windows in less than five minutes, according to the maker. All moving parts are made of steel, while the frame of the window is formed of California redwood. Because of the steel construction and the precision fitting of parts at the factory, the windows are said to remain weathertight and thus eliminate the need of refitting or rehanging.



The ready-made window unit and, at right, how it is installed

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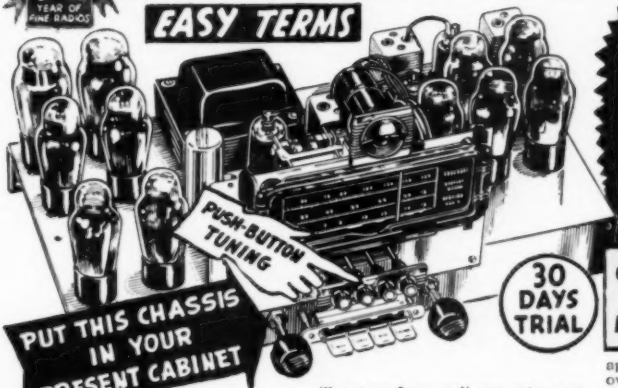

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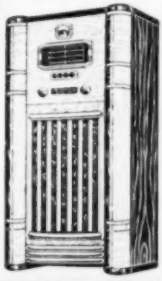

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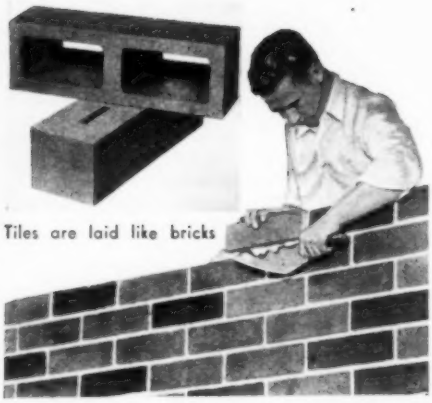

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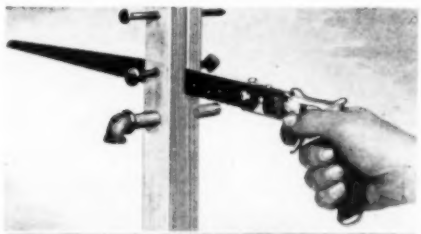

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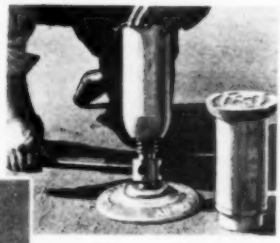

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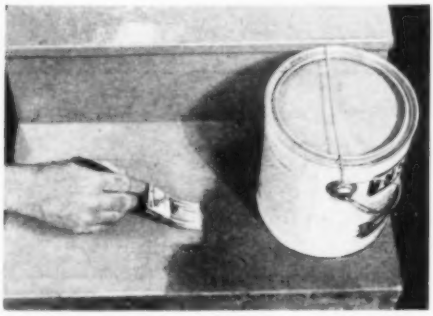

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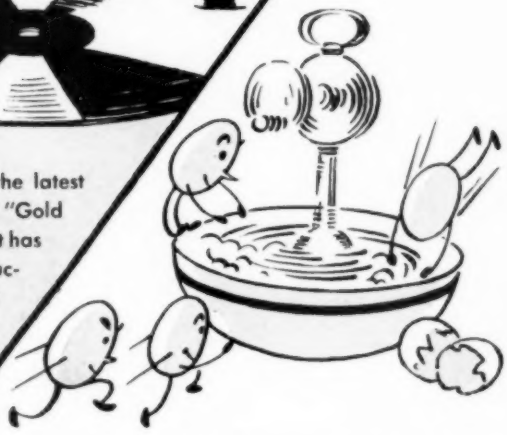

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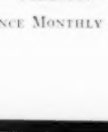

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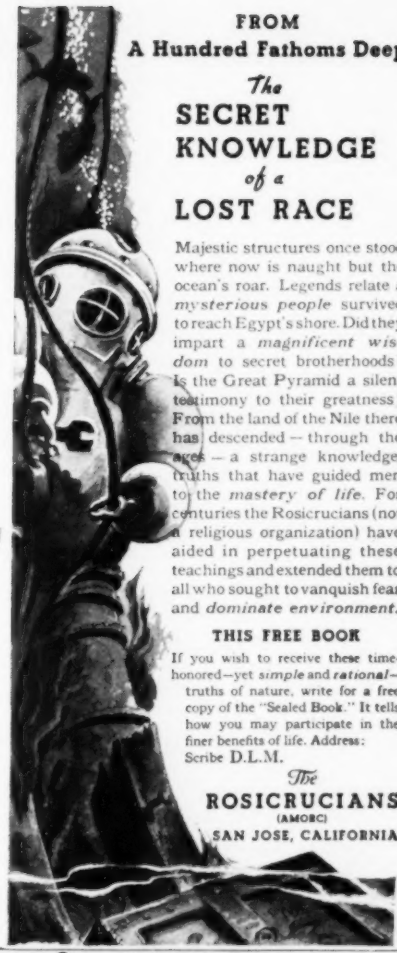

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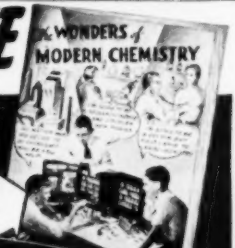

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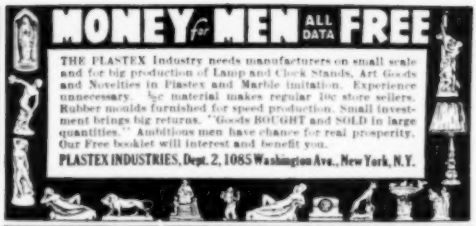

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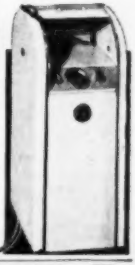

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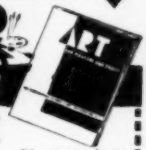

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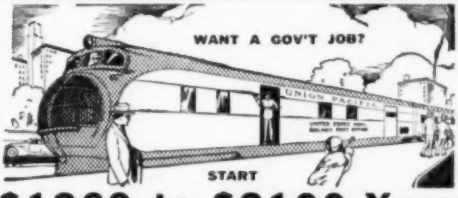

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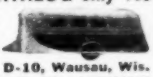

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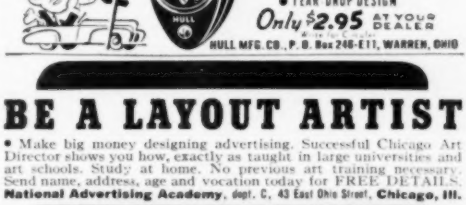
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OL' JUDGE ROBBINS

THE SHERIFF BACK HOME WRITES, 'HERE'S TO OUR NEXT PIPELOAD OF PRINCE ALBERT, AND MY BEST REGARDS TO CHUBBINS'
THAT'S NICE, DAD... OH! HERE'S THE PARADE!
DAYS OF 1881 CELEBRATION PIERRE, S.D.
THIS CITY'S RIGHT ON THE ROUTE TAKEN BY THE FAMOUS U.S. ARMY PIONEERS, LEWIS AND CLARK, IN 1804
OH, YES, THEY WERE THE FIRST TO LEAD AN EXPEDITION TO THE WEST COAST OVER THE NORTHERN ROUTE
LEWIS AND CLARK WERE SMART—THEY AVOIDED TROUBLE WITH THE INDIANS BY GIVING THEM CULTIVATED TOBACCO
YES, I GUESS THE INDIANS WERE PRETTY THANKFUL FOR A CHANGE FROM THEIR OWN HARSH STUFF
YOU BET. EVEN LEWIS AND CLARK'S TOBACCO MUST HAVE BEEN A GREAT IMPROVEMENT OVER THAT HOT-BURNING INDIAN VARIETY
JUST IMAGINE HOW GRATEFUL EVERYONE WOULD HAVE BEEN FOR OUR MODERN COOL-BURNING PRINCE ALBERT

IN RECENT LABORATORY "SMOKING BOWL" TESTS, *PRINCE ALBERT* BURNED

86 DEGREES COOLER

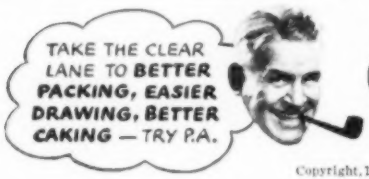
THAN THE AVERAGE OF THE 30 OTHER OF THE LARGEST-SELLING BRANDS TESTED—*COOLEST OF ALL!*

ITS DELIGHTFUL HOW COOL AND MILD PRINCE ALBERT SMOKES. THERE'S NO EXCESS HEAT TO BLUR THE FINE TASTE AND AROMA OF CHOICE TOBACCO
YES, P.A. PUTS REAL COMFORT IN PIPE-SMOKING. THERE'S NO OTHER TOBACCO LIKE IT!

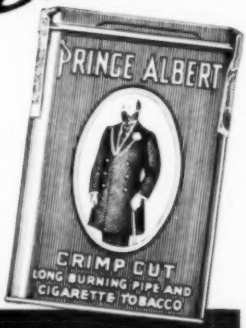
HIT THE HAPPY TRAIL P.A. TO *Smoother Smokes*

PRINCE ALBERT'S **COOL BURNING, CRIMP CUT,** AND **NO-BITE PROCESS** GIVE THE RIGHT OF WAY TO **PIPE DELIGHT!**

PRINCE ALBERT IS THE EXPRESS ROUTE TO **FAST-ROLLED 'MAKIN'S' SMOKES,** TOO — **EASIER, SMOOTHER, MILDER, TASTIER**



TAKE THE CLEAR LANE TO **BETTER PACKING, EASIER DRAWING, BETTER CAKING** — TRY P.A.



Copyright, 1940, R. J. Reynolds Tob. Co., Winston-Salem, N. C.

50 pipefuls of fragrant tobacco in every handy pocket tin of Prince Albert

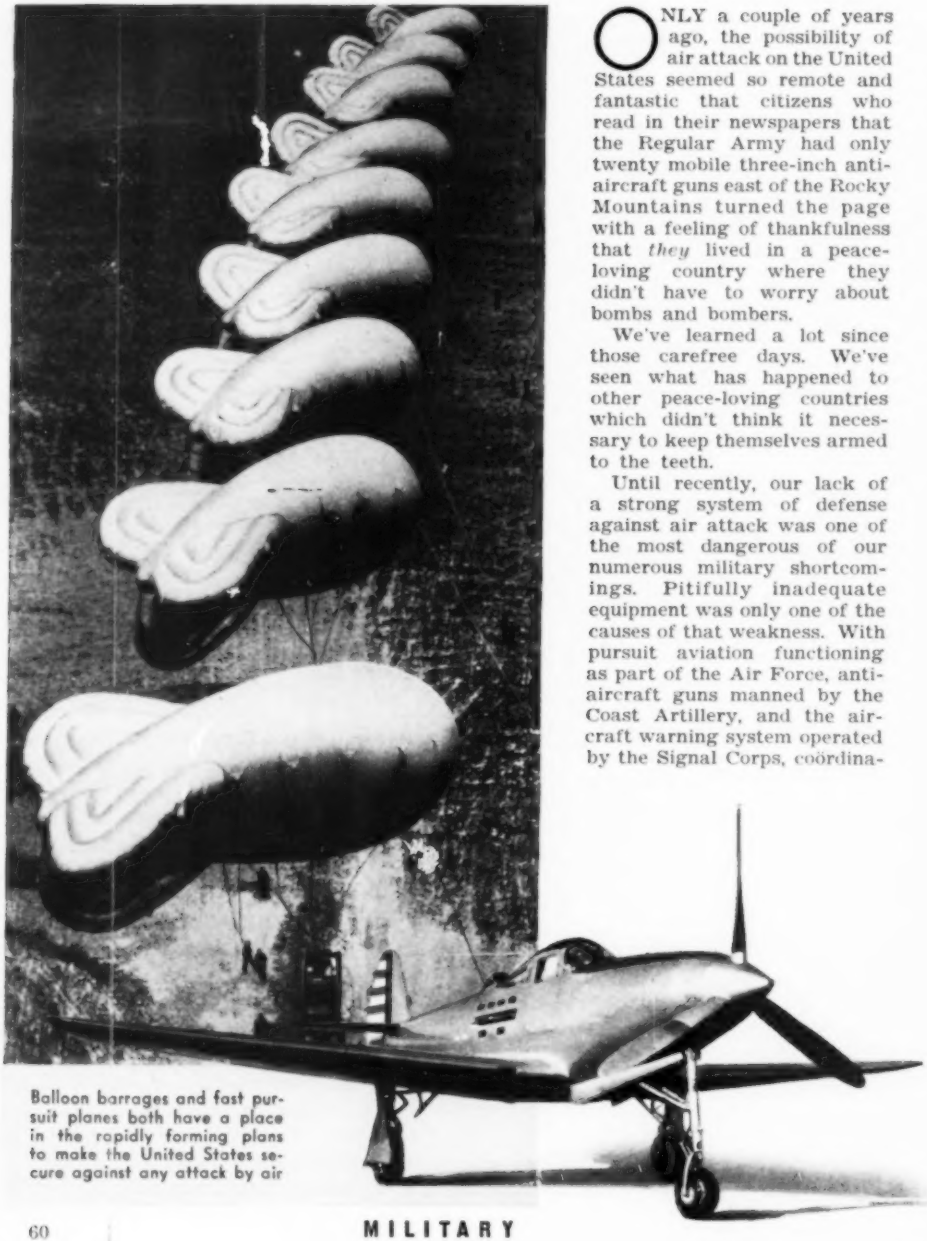
PRINCE ALBERT THE NATIONAL JOY SMOKE

The MAN of the Month

Revolutions are nothing new to Major Edwin H. Armstrong. He has fathered two in the radio industry and, today at fifty, is watching his latest brain child, F M "staticless" radio, start a third. As a motorcycle-riding sophomore at Columbia University in 1911 he jolted radio out of its crystal-detector-and-earphone days with his revolutionary regenerative hook-up. Then while eavesdropping on weak German Army stations as a Signal Corps officer during World War I he thought out the modern one-dial superhet receiver. Now, after more than twenty-five years of endless tinkering with F(requency) M(odulation) he has eliminated static—the Bugaboo of Broadcasting. Experts once said it couldn't be done, but this fall F M becomes a household reality, and radio's $4,000,000,000 industry feels another Armstrong revolution. No swivel-chair scientist, the soft-spoken, mild-mannered major expects nothing of his assistants that he won't do himself, even to dangling in a bo'sun's chair to rig antennas from the tip of the 400-foot tower that tops his Alpine, N. J., laboratory. Major Armstrong hates to have his picture taken, dislikes personal publicity, and won't have a conventional radio in his house.

BOMBERS

AMERICA FORGES NEW WEAPONS



Balloon barrages and fast pursuit planes both have a place in the rapidly forming plans to make the United States secure against any attack by air

ONLY a couple of years ago, the possibility of air attack on the United States seemed so remote and fantastic that citizens who read in their newspapers that the Regular Army had only twenty mobile three-inch anti-aircraft guns east of the Rocky Mountains turned the page with a feeling of thankfulness that *they* lived in a peace-loving country where they didn't have to worry about bombs and bombers.

We've learned a lot since those carefree days. We've seen what has happened to other peace-loving countries which didn't think it necessary to keep themselves armed to the teeth.

Until recently, our lack of a strong system of defense against air attack was one of the most dangerous of our numerous military shortcomings. Pitifully inadequate equipment was only one of the causes of that weakness. With pursuit aviation functioning as part of the Air Force, anti-aircraft guns manned by the Coast Artillery, and the aircraft warning system operated by the Signal Corps, coördina-

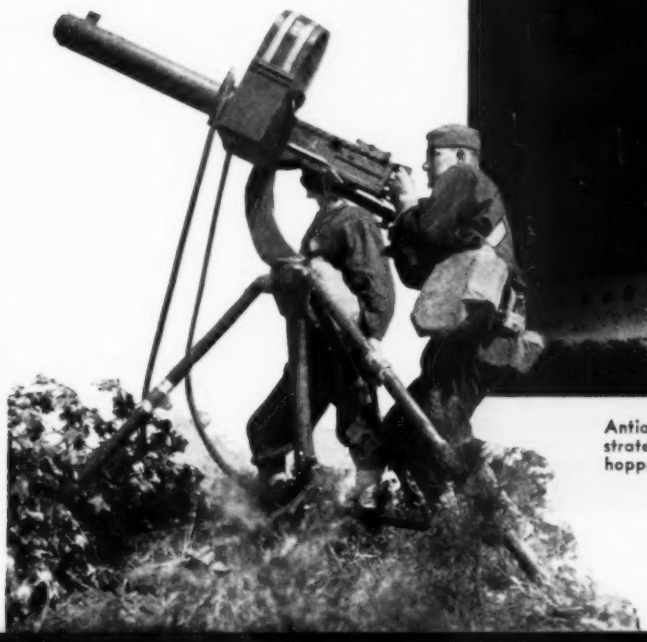
BEWARE!

FOR USE AGAINST AIR RAIDERS

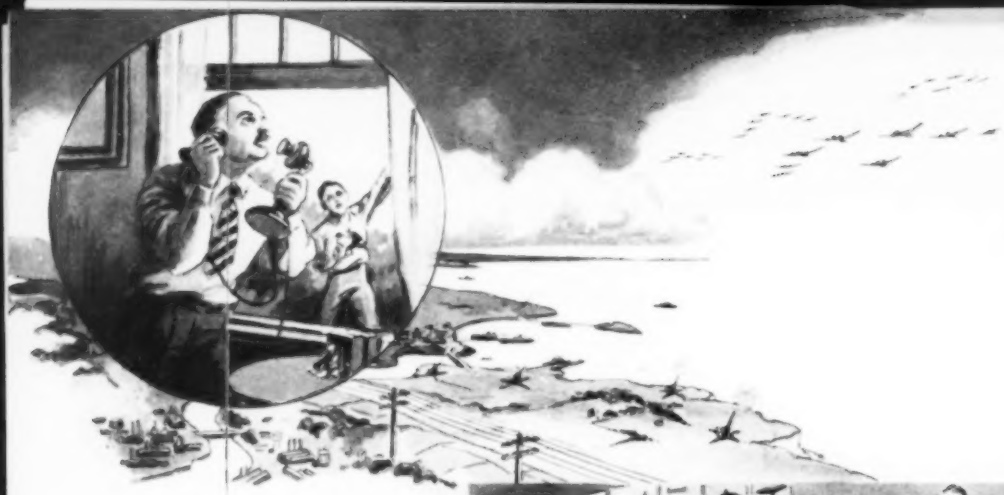
tion was impossible. Early this year a long forward stride was taken by the organization of an Air Defense Command for the northeastern section of the country. Now, for the first time, all the means and methods of air defense have been placed under the direction of a single officer—Brigadier General James E. Chaney. Although so far his Command has operated principally on an experimental basis, it is expected that the methods it has developed will be adopted as a much-needed nation-wide air-defense system.

In air defense, as in almost every other operation of present-day warfare, time is the determining factor. Bombers fly about 250 miles an hour, and pursuit aviation must have warning of their approach in time to get off the ground and into position to intercept them before they reach their objective.

Of course, the defense can save time by keeping its planes in the air instead of on the ground, but because only a small part of a patrol force can be in the air at any given time, and because the average of visibility from an airplane is only about five



Antiaircraft guns will defend big cities and strategic centers. Against low-flying hedge hoppers, .50 caliber machine guns are deadly



Hundreds of thousands of civilian observers will be trained to watch for enemy planes and report by phone to Army information centers

miles, this system is both expensive and inefficient.

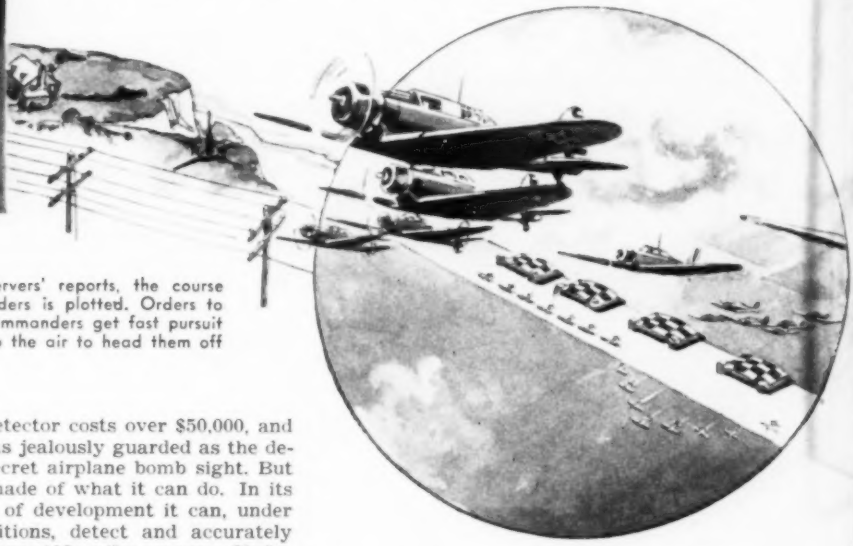
After planes on the ground receive warning of the approach of raiders, it takes them five minutes to get into the air. Although the fast fighters used for pursuit-interception work climb rapidly, it takes them between five and seven minutes to reach the 16,000-foot (or higher) altitude at which they usually operate. To have the best chance of doing their job of shooting down or driving away the attackers before they reach the bomb-release line—which for fast bombers flying at between 15,000 and 20,000 feet is about two miles short of the target—the fighters must have about ten minutes of combat time. That means that they must fly out at least forty miles to meet the attack, and that they should be warned of the approach of hostile planes while they are at least 100 miles away.

SEVERAL large-scale tests have proved that an aircraft-interception net composed of volunteer civilian observers can be depended on to give timely warning of the approach of hostile airplanes to cities or other objectives located at least 100 miles from the seacoast or a land border. With the coöperation of commercial telephone companies and the American Legion, the Air Defense Command now is organizing such a net to cover the entire northeastern portion of the country from Duluth Minn., eastward to the Maine coast and as far south as Norfolk, Va., Observation posts—which are the observers' homes—are six or eight miles apart, and as from six to eight observers are needed for each post, for twenty-four-hour duty, several hundred thousand citizens will be signed up for this patriotic service.

The operation of the system is simple. When an observer sees or hears airplanes he picks up his telephone, says "Flash!" and gives his phone number. The central routes his call over trunk lines to the nearest Army information center. A voice at the other end of the wire says: "Army—go ahead." Using a printed message form as a guide, the observer then gives the direction and approximate distance of the

planes from his post, the exact time he saw or heard them, and whatever information he can about their number, type, and altitude. As successive reports come into the information center the positions of the planes are plotted, and from these plottings their course and speed are determined. This information, flashed to the officer commanding the defending pursuit aviation, enables him to get his planes off the ground in time to meet the expected attack, and then to keep his flyers informed by radio of the position of the attackers and the direction in which they are flying. Tests have shown that the average time which elapses between the moment when an observer spots a plane and the moment its position is plotted in the information center, is less than three minutes.

To aid in the defense of cities, fortifications, and vitally important industrial areas located close to our coasts or land borders, the Signal Corps has developed an aircraft detector which is far in advance of any similar instrument used by any foreign power.



From observers' reports, the course of the raiders is plotted. Orders to defense commanders get fast pursuit planes into the air to head them off

This new detector costs over $50,000, and its design is as jealously guarded as the design of our secret airplane bomb sight. But no secret is made of what it can do. In its present stage of development it can, under average conditions, detect and accurately locate airplanes 100 miles away. Under very favorable conditions its range is close to 150 miles. Neither clouds, fog, nor noise disturb its operation, and airplane engines can't be shielded or protected against it. Some officers predict that when it has been fully developed its use may make possible deadly "blind" gunfire on unseen airplanes.

One Signal Corps company equipped with this remarkable device now is attached to the Air Defense Command. As soon as the necessary detectors can be built, four mobile Aircraft Warning Service companies, each with equipment for five or more mobile stations, will be organized for service with our field army and, if necessary, on our land borders. Six permanent warning stations are to be established on the Atlantic Coast, one on the Gulf Coast, and three on the Pacific Coast, and an undisclosed number in the Panama Canal Zone and in Alaska, Hawaii, and Puerto Rico.

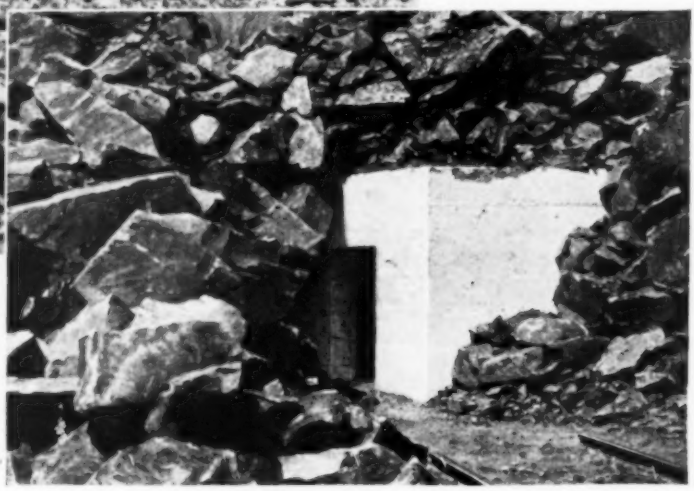
GETTING defending planes off the ground in good time usually means that the attackers will suffer considerable loss and damage before they reach their objective, but some of them are pretty certain to get through, and they must be dealt with by the antiaircraft artillery—the sky gunners who form the final protective line of air defense.

No nation has, and in all probability no nation ever will have, enough antiaircraft guns to provide this form of close-in protection for all its cities and all its important military and industrial installations. Most of our sky guns are motorized and so can be moved from place to place, but it must be remembered that in a long day they can be moved about the distance that a bomber can fly in an hour.

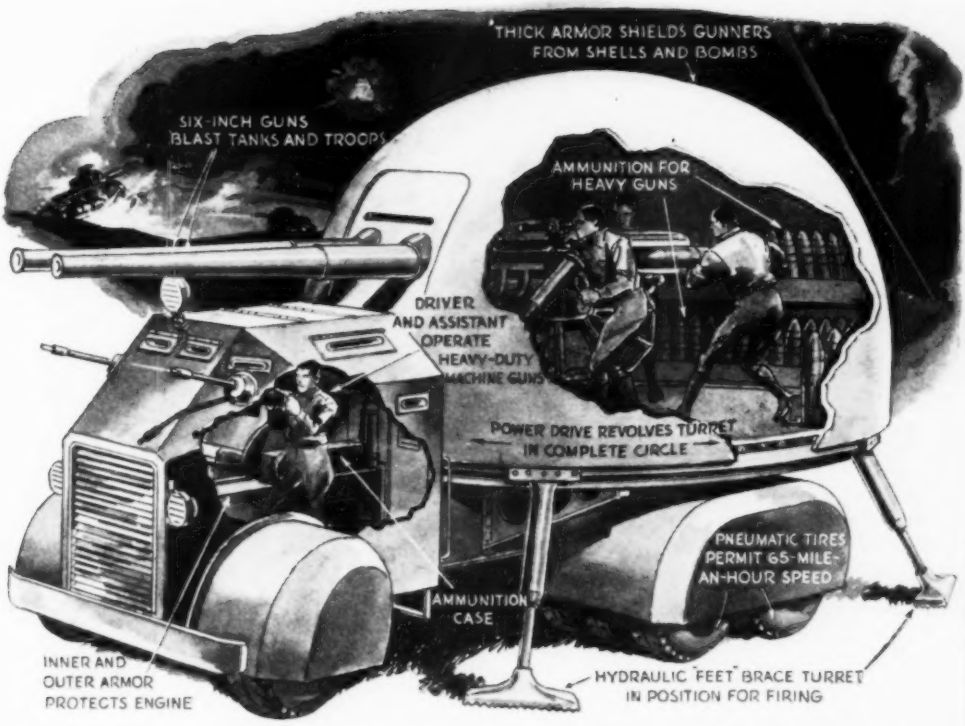
Antiaircraft artillery is a highly technical arm of our *(Continued on page 238)*

Quarry Blast Tests Shelter

SMASHING downward like a gigantic 300,000-pound hammer, 150 tons of granite plunged fifty feet and crashed upon the roof of a bombproof shelter in a spectacular test make in England. The experiment was conducted by government officials to determine the strength of a special granite-concrete construction. After the shelter had been built beneath the face of a quarry cliff, drillers bored into the granite near the top of the towering wall of stone. Dynamite, set off in the rock, tore away 150 tons of the granite and sent it plunging downward directly on top of the bombproof building below. When the cloud of dust caused by this man-made landslide had drifted aside, officials rushed forward to examine the effect. It was found that the structure was intact, unharmed by the mass of rock piled high on its roof.



Dynamite releases a man-made landslide above a bomb shelter in a novel test. As seen in the picture at right, the structure remained intact under the heavy load


THICK ARMOR SHIELDS GUNNERS FROM SHELLS AND BOMBS
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AMMUNITION FOR HEAVY GUNS
DRIVER AND ASSISTANT OPERATE HEAVY-DUTY MACHINE GUNS
POWER DRIVE REVOLVES TURRET IN COMPLETE CIRCLE
PNEUMATIC TIRES PERMIT 65-MILE-AN-HOUR SPEED
AMMUNITION CASE
INNER AND OUTER ARMOR PROTECTS ENGINE
HYDRAULIC "FEET" BRACE TURRET IN POSITION FOR FIRING

Mobile Pill-Box Fortress Mounts Two Six-Inch Guns

PILL BOXES on wheels, armed with twin six-inch guns in revolving turrets, may prove a formidable new weapon for U. S. defense. Racing to an unprotected area threatened with invasion, they would transform it overnight into a fortified zone whose strong points could be shifted at will to meet the changing battle picture. The drawing above shows unofficially reported details of an experimental model built by a Los Angeles, Calif., truck manufacturer. Subjected to four months of tests by Army engineers, it is said to have attained a speed of sixty-five miles an hour.

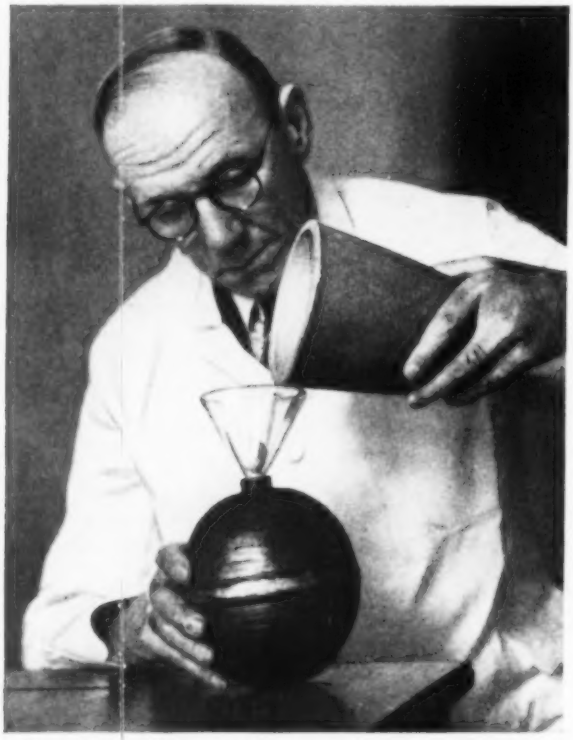
How a gunner may aim his rifle around corners or over the top of a parapet with the new sight

Sharpshooters Fire from Cover with Periscope Rifle Sight

SHARPSHOOTING acrobatics are made possible by a new L-shape "periscope sight," designed to fit any standard military rifle. Without exposing himself to enemy fire, an infantryman using the sight may look, aim his gun, and then fire it around a corner of a building, or over the top of a protecting parapet, without exposing himself to the fire of enemy sharpshooters. The sight is being demonstrated at the left.

Floating Fortress Lies in Ambush for Enemy Shipping

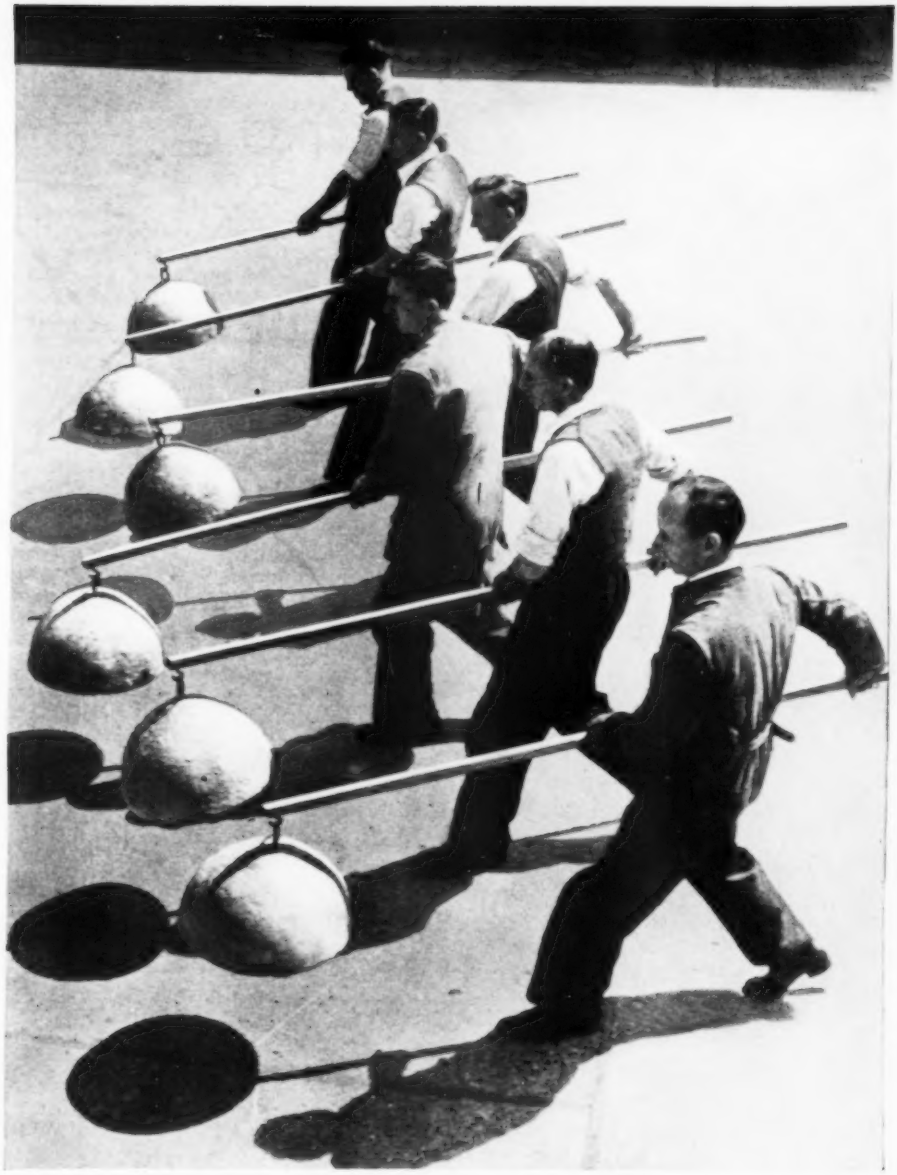
FLOATING forts in the form of low-lying armored barges, fitted with eight-inch guns, represent a new type of fighting craft in the Italian Navy. The photo above, snapped by an American seaman, shows one of the armored rafts at Genoa. Towed to sea by ships, such marine forts are left in strategic positions to prey on enemy ships, which cannot sight them until they are already within range of their guns.



Filling a bomb with "Ignite." Loading is done at low temperatures

Contact with the Air Sets Off New Powder for Incendiary Bombs

AS THE result of researches carried on in a laboratory in Melbourne, Australia, Dr. J. R. Atcherley has announced the perfection of a new type of incendiary powder for use in aerial bombs. The unique feature of his chemical combination, he reports, is that, except at low temperatures, the powder spontaneously bursts into flame as soon as it comes in contact with air. This eliminates the necessity of using an elaborate fuse or other igniting mechanism. As soon as the bomb strikes the earth and breaks, its contents begin burning at a temperature of 3,000 degrees C. The newly discovered powder, called Ignite, has been tested before government experts in the laboratory and further experiments are being carried on under actual bombing conditions in which the trial missiles are dropped at proving grounds and the resulting damage is studied.



Odd Snuffers Smother Incendiary Bombs

SNUFFERS for incendiary bombs are among the latest inventions for air-raid defense. Shaped like inverted bowls, and formed of asbestos sprayed over a wire-mesh foundation, the snuffers are attached to the ends of long poles by means of easily disengaged hooks. Dropped over blazing fragments, the asbestos bowls are designed to snuff out the blazing chemicals and prevent the spread of the fire.

UNCLE SAM DRILLS

PARACHUTE troops for the U. S. Army have just had their first mass trial at Hightstown, N. J. Two officers and forty-eight enlisted men, chosen from volunteers at Fort Benning, Ga., recently formed an experimental platoon to test large-scale training methods. If War Department officials pronounce the innovation practical, the fifty pioneers may become the nucleus of an expanded, European-style "air infantry."

For the initial experiment, Army men used a pair of 125-foot parachute - jumping towers operated at Hightstown by a civilian concern. Military

American doughboys drop from the sky at Hightstown, N. J. This man is spilling the air from his 'chute after a leap from the 125-foot training tower. At top, another is being hoisted to the top for a jump

PARACHUTE TROOPS

technique developed here gradually accustoms a novice to the feel of a real parachute drop, in complete safety.

A learner first drops in a permanently opened parachute, guided by wires, as at amusement parks. Instead of sitting in a swing, however, he wears a standard harness, and is taught how to absorb the shock of landing on his feet.

With the parachute still open, but without the guide wires, the jumper next tries free drops. For this purpose, the parachute-launching boom can be rotated according to wind direction, so that he always will drift away from the tower. An instructor shows him how to spill the air from his 'chute, as soon as he lands, so as not to be dragged along the ground by a breeze.

Finally the student "bails out" with a folded 'chute, pulling a rip cord to open it, as he would do in actual warfare. If he delays overlong, a safety cable brings him to a stop without injury.

By these easy stages, it is proposed, large bodies of U. S. Army infantry could quickly be turned into experienced 'chutists. Successful European tactics suggest that they would be dropped behind enemy lines to capture and hold key positions, until reënforced by air or land.

It is interesting to note that the United States Army was among the first to experiment with the use of parachute troops, conducting tests at Brooks Field, San Antonio, Tex., as reported in the February 1929 issue of POPULAR SCIENCE MONTHLY.

Beginning a free drop with the 'chute open. To keep the jumper from being blown against the tower, the boom is turned with the wind. At left, a student has his harness adjusted

What Are the Facts About FM?

A few years ago, prominent radio engineers "proved" by mathematical and other means that the periodic banging and crackling of static in your loudspeaker could never really be eliminated. They were wrong. For the development of a system of radio broadcasting known as FM (frequency modulation) has not only conquered the static bugaboo, but has given birth to other innovations that may well cause a revolution in America's $4,000,000,000 radio industry.

What are the facts about FM? This article answers the questions most frequently asked.

By E. W. MURTFELDT

◆ *First of all, just what is FM?* Frequency modulation, generally shortened to the initials FM, is a new type of radio communication that is static-free and almost unbelievably lifelike in tone.

◆ *What is the name for the present system of broadcasting?* Amplitude modulation, or AM.

◆ *Who developed FM?* Major Edwin H. Armstrong (see page 59).

◆ *Are FM programs being broadcast at the present time?* Yes, from a number of transmitters operating under experimental licenses, most of them in the East and the Mid-West. You may not be able to get FM programs in your locality at the present time, but every month new FM stations are springing up in all parts of the country. Broadcasting of FM programs on a commercial basis is scheduled to start early next year, according to present plans.

◆ *Can I hear FM programs on my present set?* No. To hear FM programs you must have a special FM receiver.

◆ *What wave lengths does FM use?* FM has been assigned a band in the ultra-high-frequency range, extending from 42,000 to 50,000 kilocycles. That wave length is far below the regular broadcasting stations you hear at the bottom of your radio dial.

◆ *Will the introduction of FM make my present radio obsolete?* No. Your favorite programs will continue to be broadcast by the existing AM method for some time to come. Your present set won't be able to pick up the programs broadcast solely by FM transmitters, but FM's proponents expect that the major radio shows will soon be broadcast by both FM and AM simultaneously. Possibly both types of broadcasting will continue to exist side by side. But if FM ever entirely replaces AM, a good many years will have passed and you will be in the market for a new set anyway, as your present receiver will be obsolete.

◆ *Do all the experts believe that FM is so superior that it will eventually knock AM completely out of the picture?* No. Some think that AM is plenty good enough as it is. Others feel that improvements in AM methods could approximate FM's tone—and anyway, they argue, you don't need super-high-fidelity to enjoy "Amos 'n' Andy." Because FM's range is comparatively small (fifty to 100 miles), many more stations will be required, and the problems of a coast-to-coast FM network are many. But FM supporters see advantages in many of the points that FM opponents list as drawbacks.

◆ *Are FM receivers on the market now?* Yes.

◆ *How much do they cost?* From about $600 for the most elaborate type down to around fifty dollars

Frequency modulation was developed by Major E. H. Armstrong (page 59)

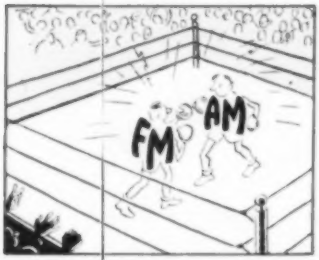
Even in the midst of a severe lightning storm, programs broadcast by the new system are received distinctly

Man-made static, too, is licked by FM. You can use your electric razor and listen to the radio at the same time

Because height gives wider range to FM signals, there may be a scramble for mountain-top station locations

Tests have shown that FM has great advantages in police work. It also is likely to find wide use in aviation . .

. . . and in warfare, especially for tanks and planes. The U.S. Army and Navy have been experimenting with it



Amplitude modulation, the common system of broadcasting, will have some keen competition from its new rival

for a small set. This smaller unit can be hooked up to your present radio so that you can enjoy both AM and FM programs from your present loudspeaker. Most of the new FM sets will receive AM programs as well. Most manufacturers expect the price to come down as FM-set sales volume rises.

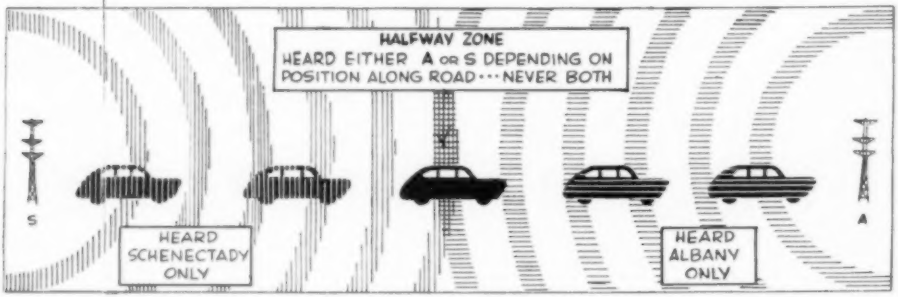
◆ *Don't you hear* any *static with FM?* Well, General Electric engineers recently placed a radio cabinet housing both an AM and an FM receiver in the laboratory where they create million-volt artificial-lightning storms. They tuned the AM set to WABC, in New York City, and the FM set to W2XMN, Major Armstrong's experimental transmitter at Alpine, N.J., which was rebroadcasting WABC programs by frequency modulation. With the man-made lightning snapping only a few feet away, they turned the AM set on and heard nothing but a bedlam of static from the loudspeaker. Then they switched to the new FM receiver. The program came through with almost perfect clarity, with nothing but a slight undertone of static buzz, too faint to mar the program. (Page 70)

◆ *That sounds convincing, but suppose I tuned in an FM set during a* real *lightning storm. Would I hear the program clearly and without static?* Yes.

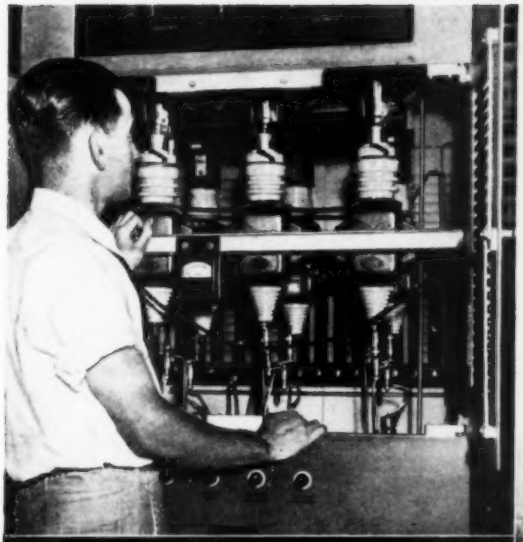
◆ *Well, suppose I sat next to an FM set and shaved with an electric razor. Wouldn't the man-made static caused by the razor motor be reproduced in the loudspeaker?* No. And the same holds true for oil-burner motors, diathermy machines, vacuum cleaners, and all the other common static makers.

◆ *How about the tone of an FM radio? Is it really better than an AM set?* Yes. FM is astoundingly lifelike: Two comedians carrying on a dialogue sound as though they were hidden just behind your loudspeaker grille. Symphony music is so clear and brilliant that you can practically pick out each instrument. For FM reproduces a far greater range of audible frequencies than present methods. Extremely high and low tones that are now lost, are reproduced by FM with near-perfect fidelity.

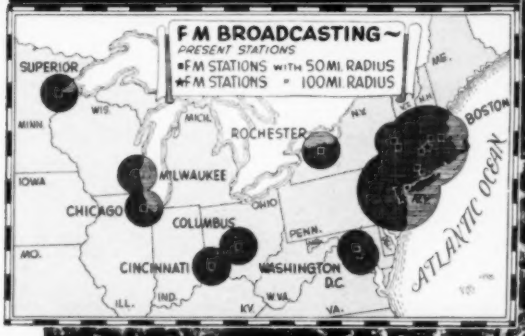
◆ *How about interference, squealing, and fading caused by two stations on the same or near-by wave lengths? Does FM eliminate* (Continued on page 237)



This test proved that even if two FM stations use the same wave length, you never hear both at once



A rectifier unit in the Armstrong experimental station at Alpine, N. J., seen with its 400-foot antenna tower in the large photograph. Map below shows the pioneer FM experimental broadcasting stations. More are being built.



His Vision

The True Story of a Boy Who Had a Big Idea and Followed It Through to Final Success

By ELLIOTT ARNOLD

THE only trouble with Philo T. Farnsworth's story is that it is out of time. It belongs to another day. It ought to be a hoary legend now and it's just twenty years old and still in the making.

It has everything the school teachers love—boyhood on a farm, the dreamy inventor, the years of struggle, success. It's the story of television and it all took place when folks whose names slip the mind for the moment did a lot of shouting about the frontiers being gone.

Farnsworth dreamed of television without moving parts when he was thirteen; a year later, still in high school, he invented some of the basic parts of electronic television. In 1927, when he was twenty, he took out his first patent, on an entire television system—not just one part—and Donald K. Lippincott, the radio engineer, called him "one of the ten greatest mathematical wizards of the day."

Today, at thirty-three, Farnsworth is vice president and general director of research of the Farnsworth Television & Radio Corp. Such organizations as American Telephone & Telegraph, Radio Corporation, and Philco have taken out licenses under Farnsworth patents. Foreign licensees include Baird Television, Ltd., of England; Fernseh

Philo T. Farnsworth training a television "eye" on a dance team. Above, he is seen at work in his Fort Wayne laboratory

Made Television

Aktiengesellchaft of Berlin, and T. C. Rethers of Australia.

The story of Farnsworth, a painfully shy man, starts with his grandfather, the first Philo Taylor Farnsworth, who established the Mormon community of Beaver City, in Utah, under instructions of Brigham Young.

Philo's father settled a farm there, and Philo grew up on it. When he was six he played constantly, not with wagons or tin soldiers, but with a toy dynamo and a tiny electric motor. One day he rigged the dynamo to the wheel of his mother's sewing machine, generating enough electricity, while she sewed, to operate the motor. His mother hoped he would let it stay that way for a while, but the boy's interest was too feverish. He took the motor apart and put it together again.

When he was twelve the family moved by wagon train to Rigby, Idaho, and worked a ranch in the Snake River Valley. The place was the answer to a young inventor's prayer. It was littered with equipment, including a private light and power system, power-operated hay hoists, and harvesting devices that worked electrically.

The inventor watches the screen of an experimental receiver

The mechanical and electrical gadgets were total mysteries to all except Philo, who went for them with a wild shout of glee. He took everything apart and put it together again. He arrogated to himself the sole right to keep the equipment in repair, and it was no contested position, since no one else could do more than push the right button.

He had the equipment working so smoothly it got to be no fun at all. His family swears he deliberately put parts of it out of commission when things got dull, just so he could take them apart and fix it.

His folks had been hoping maybe he would be an artist, and optimistically had been feeding him violin lessons. He turned out to be a pretty good player, but it never became more than a relaxation. He is a good violin player today and is an expert pianist.

When his folks got wise to the planned vandalism of the machinery on the farm they thought they would put an end to it. They gave him a new chore to keep him out of mischief—operation of the gigantic family washing machine. But they didn't know their son. Farnsworth became fed up with moving the handle back and forth and rigged up an electric motor, winding the intricate coils of the armature himself, and soon had a power-operated machine. He was not yet thirteen.

A new idea takes shape on paper. Farnsworth was thirteen when he got the inspiration that has guided his work in television

Farnsworth, a very modest man, does not offer any of this information with the intention of trying to limn the early life of a genius.

"The only significant thing in all this," he says, "is that it gave me a background at a very early age of the elements of electricity, and gave me an incentive to study electric physics and, through the medium of popular magazines, a knowledge that there was such a thing as television."

The boy read everything he could lay his hands on that dealt with television, as it was being planned then, and finally he asserted to all who would listen to him, that the research experts were barking up the wrong tree trying to develop a television system by mechanical means.

The major experimenters were using mechanical whirling disks to scan the image. Farnsworth declared that this would get them nowhere, for the simple reason that the transmission of a satisfactory image required scanning speeds greater than any whirling disk could reach and maintain.

Electrons, he said, moved with the speed of light itself, and they could do the job if properly harnessed and controlled. That conception is the basis of today's electronic television—television with no moving parts—and it emerged from the head of a boy who hadn't yet started to shave.

"I had a theme for research which continued through the years as a guiding light," he says, "or as a direction for research and development; namely, the elimination of all moving parts from television equipment.

"The idea I had fairly well established in 1921 when I was thirteen, so that the moment I discovered tools—out of textbooks I mean—which would enable television to be done without moving parts, the invention seemed almost simultaneous; as a matter of fact, simultaneous with the discovery that there was an electron and a photo-electric effect.

"In 1922, when I was a freshman in high school, I made my first big invention in television—and it consisted of a means of producing an electric counterpart of an optical image. At that time it was a daydream, a daydream only. I had no facilities for doing research. I had no money to buy equipment.

"All I had was access to a very modest school library, and my sum total of equipment for forming any definite practical idea as to the problem of television consisted of a static generator in the high-school physics laboratory, and an old Braun tube."

ONE of his high-school teachers, Justin Tolman, took a great interest in Farnsworth. The teacher and pupil used to hold long conversations on the molecular theory of matter, the structure and nature of electrons, and Einstein's theory of relativity. The teacher later said that young Farnsworth's discussion of the theory was the clearest and most concise he had ever heard.

One day after school Farnsworth started to draw on the blackboard. He worked for hours, correcting, erasing, and then he began to explain it to his teacher. It was his conception of an electronic television system.

The teacher studied for a long time, and then admitted it was beyond him. He gave the boy the most advanced textbooks on the subject he could think of, and told him to go on with his dreams.

Soon after the Farnsworth family moved to Provo, Utah, and young Farnsworth took some special courses in Brigham Young University. In *(Continued on page 236)*

Courtesy New York Herald-Tribune

Unshackle Him!

• When "Ding" penned this cartoon some months ago, America's great defense program was just beginning to roll. Today, industry has gone to war. Our powerful industrial giant is slipping free of his shackles and the smoke of activity is pluming from the nation's factories. To provide our readers with an authoritative background against which to project the news of the day, **POPULAR SCIENCE MONTHLY** presents on the following pages the first of a series of dramatic articles revealing just how industry is being mobilized to arm Uncle Sam's vast forces of defense for guarding our country against the danger of attack from any quarter.

Industry Goes

★ HOW AMERICA IS MOBILIZING THE MEN BEHIND THE MAN WITH THE GUN

AMERICAN industry is mobilizing its men and machines to fill the biggest and most important order it has ever received. Time-to-go-to-work whistles that have been silent for years are blowing again. New plants are being built. Government arsenals are working three shifts, six days a week. By next spring our manufacturing machine will have been shifted into high to turn out the airplanes, guns, fighting ships, and munitions we must have to make us safe against any form of aggression.

It took Hitlerized Germany seven years of peacetime "total" mobilization to get ready for the current war. Never in all history had there been anything that equaled that awe-inspiring national effort. It was a peacetime mobilization that missed no one. Industry was controlled by the placing of "must" orders and the allotment of raw materials, and the salaries of its executives were limited by government regulation. Labor, which worked seventy hours a week, was controlled by the outlawing of unions, prohibition against changing jobs without official approval, and outright conscription. Capital was controlled by compulsory investment of profits in no-interest government securities or in unprofitable enterprises. It was strictly an "or else" program. Orders were backed up with threats of heavy fines, economic ruin or, for the really obdurate, a concentration camp or even a firing squad. Those seven years cost the German people their political and economic freedom and the equivalent of 40,000,000,000 American dollars, but they gave the Nazis the most nightmarish war-making machine the world has ever seen.

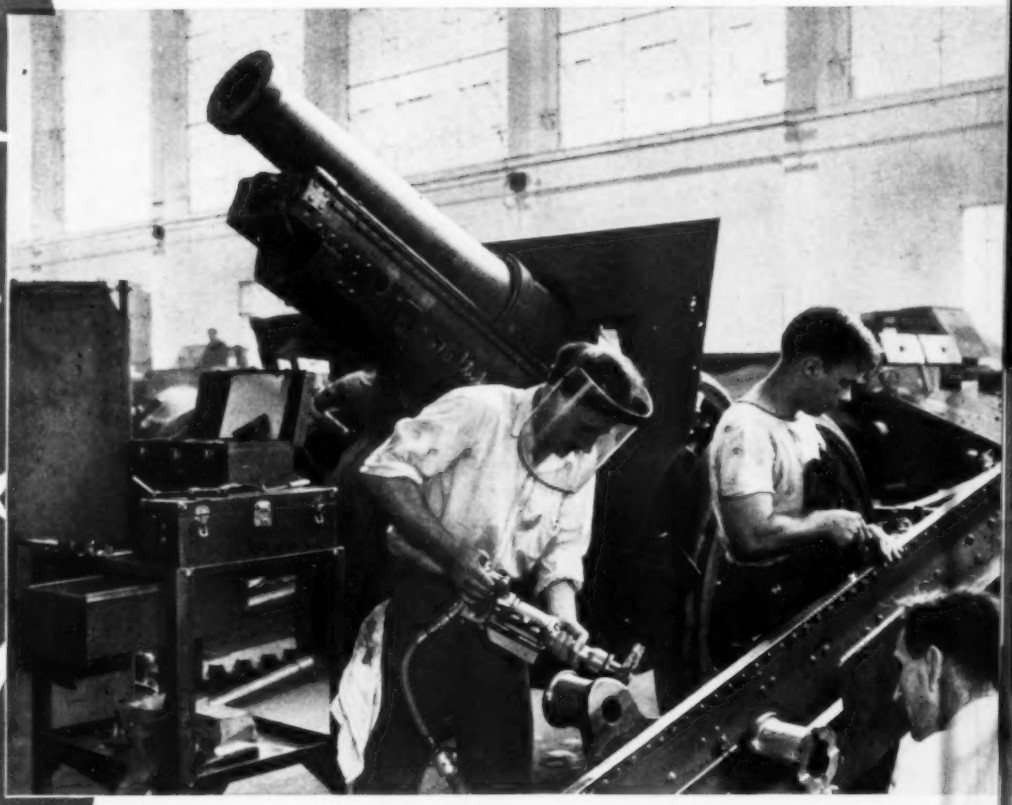
In an effort to assure the safety of the United States in a world which gives every indication of remaining rough, tough, and dangerous for a good many years to come, Congress in the course of its present session has appropriated over $10,000,000,000 in the form of cash and of contract authorizations, for national defense.

Those appropriations will be spent to order 14,394 airplanes for the Army and Navy, and so make a start on a program which calls for the production of 25,000 planes a year by July 1942; to procure complete armament and equipment for a modern, highly mechanized army of 1,200,000 men, and the hard-to-get-in-a-hurry items of armament and equipment for an additional 800,000 men; to start the building of approximately 200 additional fighting ships which will give us a Navy powerful enough to control the Atlantic and the Pacific at the same time; and to provide new national-defense construction and manufacturing facilities, including the expansion of ship-

Playing a march on a xylophone of [illegible] an inspector stamping 155-millimeter shells

to WAR

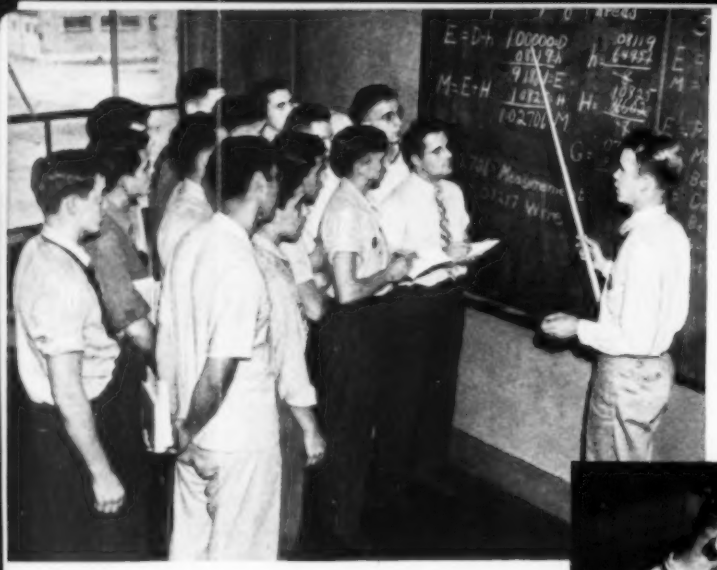
By ARTHUR GRAHAME



yards and the building of thirty-one ordnance plants far enough away from our coasts to be beyond the range of air attack. Congress has supplied the necessary billions. Transforming those billions into bombers and fighters, into antiaircraft cannon and field guns, into ships, tanks, motor trucks, O. D. uniforms, Garand rifles, undershirts, and the 70,000 or so other things the fighting services need is industry's big job.

Hitler, using the dictatorial *"entweder oder"* method of getting things done, achieved astounding results by handing Germany's industrial mobilization over to the rotund, hard-boiled, and able Marshal Hermann Goering and his economic general staff of impressively uniformed officials. Uncle Sam, sticking to our democratic "Let's go, gang!" method of voluntary coöperation, is confident of getting equally satisfactory results by having the production end of our preparedness program guided by industrial experts who work for the Government for nothing a year and who think, act, and look very much like the thousands of other doing-all-right Americans you can see any week day on New York's lower Broadway, Chicago's LaSalle Street, Detroit's Cadillac Square, or at the Rotary Club luncheon in Springfield—Massachusetts or Illinois.

To get those experts on the job, late in May President Roosevelt used the powers



MEN FOR THE MACHINES

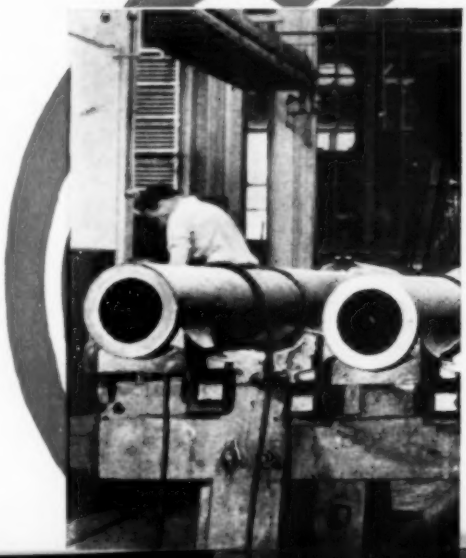
Apprentices at a Government arsenal where workers are being trained to meet the need for skilled manpower. Below, a young machinist with his diploma from a course at a large factory

of the National Defense Act of 1916 to revive the World War Advisory Commission to the Council of National Defense, which had been dormant for almost twenty years. The Commission acts as a coördinating agency between the Government departments which have to procure national-defense material for the armed services and the industries which will have to provide it.

When he made his appointments to the key positions on the National Defense Advisory Commission, President Roosevelt gave the world a convincing demonstration of the fact that the United States still is a country where the really big jobs go to men who have proved that they have what it takes to handle them.

William S. Knudsen, automobile assembly-line wizard left his big job as president of General Motors to coördinate the production of defense material, break bottlenecks, and be the Commission's all-around trouble-shooter. Edward S. Stettinius, Jr., resigned his $100,000-a-year position as chairman of the board of the U. S. Steel to become the Commission's procurer of raw materials. Sidney Hillman, who is in charge of coördinating labor and of training workers for the defense industries, has been president of the Amalgamated Clothing Workers of America ever since the organization of that union in 1914.

The other members of the commission are Ralph Budd, the president of the Chicago, Burlington and Quincy Railroad, in charge of coördinating all our transportation facilities; Chester C. Davis, a member of the Federal Reserve Board, who is responsible for accommodating agricultural problems to the defense program; Leon Henderson, of the Securities and Exchange Commission, in charge of the statistical study of prices; and Miss Harriet Elliott, dean of women



of the University of North Carolina, whose duties include the protection of consumers and trying to keep down the cost of living. None of the commissioners receive salaries, but the Government pays their expenses. All of them are assisted by staffs of executives and expert advisers.

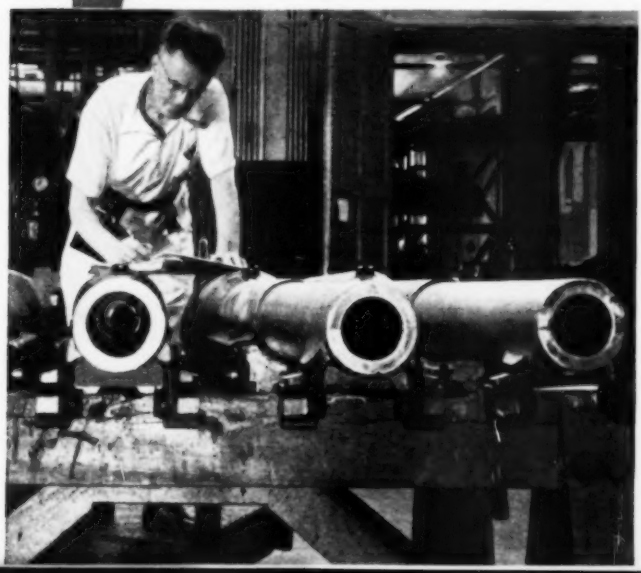
While the Commission has no formal executive authority, it reports directly to the President, and under the National Defense Act the President has all the authority he needs to drive through the defense program—authority to establish priorities which would give Government orders the right of way whether or not business men liked it, and authority to place compulsory orders. So the Advisory Commission has iron fists, although it has worn, and is likely to continue to wear, velvet gloves over them in its dealings with industry.

Its methods are well illustrated by its handling of the question of priorities. Suppose, for example, that Greene & Browne, who are in the toy business, decide to bring out a new design kiddie car, and place their order for the machine tools necessary to manufacture it. A week or two later Black & White sign a contract to make—let's say—antitank-gun parts. They must have specially designed machine tools to make them, and they can't get those tools in a hurry because Greene & Browne got their order in first. Black & White go to the Advisory Commission with their troubles. Antitank guns being, in the present unhappy state of world affairs, considerably more essential to the nation's welfare than kiddie cars, the Commission could ask the President to paste a priority label on Black & White's order, and Greene & Browne would have to wait and whistle for their tools. But the Commission doesn't do that. Instead, one of its representatives calls on Greene & Browne and explains the situation. Greene and Browne go into a huddle and, being patriotic citizens, come out of it with an offer to hold over their new kiddie car until next year so that Black & White can get those antitank-gun parts into production.

Assembling a Garand rifle at the U.S. Arsenal at Springfield, Mass. Production of this new infantry weapon was speeded up by the defense program

The Commission calls that the preference, or voluntary priority, system of procurement, and up to date it has worked so well that there has been no need to enforce legal priorities in order to get results.

The way in which Ralph Budd, the Commission's transportation coördinator, deals with the railroads provides another example of the "Let's go, gang!" method of getting things done without fuss or bad feeling. Noticing that on June 1 there were almost 164,000 box and open-top cars—slightly over ten percent of the railroads' freight-carrying rolling stock—awaiting repairs, and anticipating heavy



After reconditioning, these 75-millimeter field-gun barrels will be mounted on new high-speed carriages

defense industry traffic this fall, he wrote (as one railroader to another) to the president of the Association of American Railroads suggesting that to make sure that they would be able to do their part of the defense job the lines should reduce the proportion of "bad orders" to less than six percent by October 1. The October figures aren't available yet, but it's a dollars-to-doughnuts bet that when they are released they will show that the number of cars needing repairs has been reduced below the requested figure.

ITS ability to make good use of the personal approach is one of the Advisory Commission's biggest assets. The automobile manufacturer who gets a letter from it asking him to go into the making of airplane cannon knows that it didn't come from some War Department brass hat, but from Big Bill Knudsen, the fellow who knows all about assembly lines. The union official who is asked to solve the labor problems of a shell-making plant knows that he isn't dealing with some office-holding theorist but with Sid Hillman, a veteran labor man. Gaudy uniforms and high-sounding titles may impress people in some countries, but American business men like to do business with men who wear the same sort of clothes they do and who speak their language. That's one of the reasons why, even if some day we should get into a big war, our industrial effort will be guided by civilians.

One of the reasons for bringing Knudsen to Washington was that he is a famous breaker of production bottlenecks. The first bottleneck he attempted to break on his new job was in the machine-tool industry. Machine tools are necessary for the production of every weapon from a .30 caliber rifle to a sixteen-inch harbor-defense gun. Shells can't be made without turning lathes, and the armor plate for a battleship can't be worked without huge planers and millers. A serious shortage of machine tools would block our defense campaign before it ever got started.

The firms in the industry offered the Government 100-percent coöperation, individually and through the National Machine Tool Builders Association. They already had cracked one of their own potential bottlenecks by starting to train workers both in their plants and in coöperation with vocational schools. Priorities weren't necessary. All that was needed was to tell the tool makers what the Government wanted first. They put their facilities as completely at the nation's service as if war had been declared. They coöperated with the Commission's and the Army Ordnance Department's experts in designing a machine which doubles the production of rifle barrels, and in the development of a simple single-purpose lathe which can, if necessary, be operated by a woman and which can be produced by others than expert machine-tool makers. The work of the tool-making industry hasn't been spectacular, and some of it of necessity has been slow, but it has been highly effective.

Many people have feared that a shortage of some critical raw material might seriously handicap our rearmament. That is possible, but the danger seems remote. We have nearly all of the materials we need, and have them in quantities which are practically inexhaustible. For some years Government agencies have been building up stock piles of materials which we can't produce and which we might have trouble in getting in an emergency. Just how large those stock piles have grown no one outside the Government knows, but it is no secret that since Stettinius was appointed to the National Defense Advisory Commission's procurement job he and his staff have displayed very considerable ingenuity in adding to them.

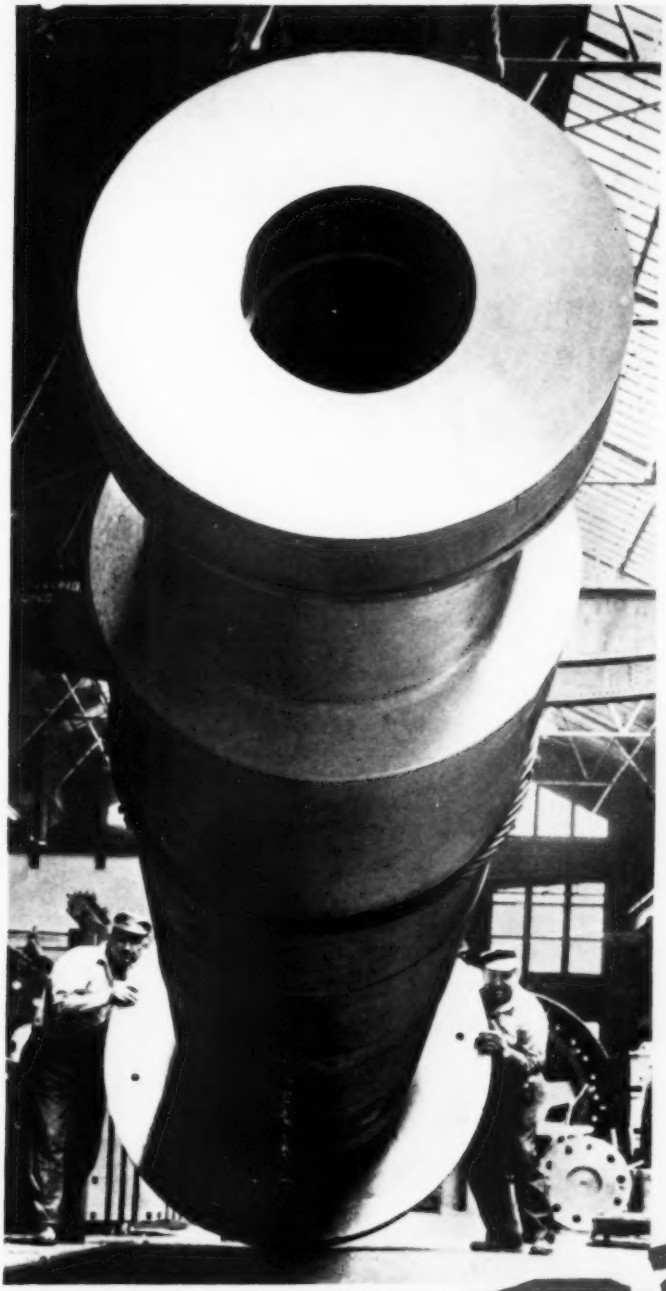
Most of our rubber comes from the Malay Peninsula and the East Indies, and our supply might be cut off if Japan went on the warpath against us. That would have been fatal twenty years ago, but it is much less serious today. Several American manufacturers are ready to undertake the large-scale production of synthetic rubber made from petroleum.

Ordinary gasoline, the lifeblood of mechanized warfare, presents no problem. Our supply of 100-octane gas, of which our expanded air forces will use tremendous quantities, is being conserved by means of an embargo, and adequate reserves are being stored in safe places.

The chemical industry is coöperating whole-heartedly in the national effort, even to the extent of its members exchanging closely guarded secret formulas with their competitors!

EVERY bit as vital to our national defense as the man with the gun are the men behind the man with the gun. The number of workers necessary to arm and equip each soldier and keep him supplied with the food, ammunition, clothing and all the other things he needs in war have increased in proportion with the increased mechanization of warfare. In the World War we needed six workers for every soldier. At the outbreak of the present war German military authorities estimated that they were going to need eighteen workers for each soldier!

Rearmament is different from war because it doesn't have to make good the in-



INDUSTRY'S BIG GUN: The sixty-five-ton shaft of a 75,000-horsepower generator to be installed at Bonneville Dam, in Oregon. The power it turns out will help to make our country safe from aggression

credible loss and waste of war, so we won't need so high a ratio of men in overalls to men in uniforms. Industrialists figure that during the coming year our defense program won't demand more than a tenth of our industrial productiveness.

After investigating our probable manpower needs, Sidney Hillman says that the reservoir of our 5,500,000 unemployed workers will take care of most of our labor problems of the near future. Many of these men are unskilled, but many others of them *were* skilled, and the Government is giving them the opportunity to take refresher courses, at W. P. A. wages, to bring back the skill they lost during their years of rusting. Large numbers of unemployed youths are being trained for the defense trades. The Government also is coöperating with employers in providing on-the-job training for employed workers who want to qualify for better jobs, and in training apprentices. The United States Employment Service, which has over 1,500 offices, will help in bringing the right worker and the right job together, and in overcoming labor shortages in individual trades and in particular localities.

We have the money, we have the materials, we have the manufacturing facilities, and we have the men. What are we doing with them? Are we getting anywhere with our rearmament job?

Perhaps our progress in increasing our [illegible] disappointing to optimists who expected to see [illegible] 50,000 airplanes. President Roosevelt mentioned the [illegible] before this winter. It [illegible] disappointing to the men in the industry who

knew the tremendous amount of make-ready work which would have to be done to increase production from a few hundred planes and engines a month to 50,000 planes and 125,000 engines a year. Most of the planes on order now are training planes—they are needed first. Knudsen is confident that the industry, in addition to filling its British contracts, will be able to give us 18,000 Army and 7,000 Navy planes by July 1942. It will take at least another two years for it to reach the 50,000-a-year production level.

Most of the 10,340 large and small manufacturing plants—located in forty-five states—which have been approved by the Army and Navy have received orders and are working on them.

AMERICAN industry is literally beating plowshares into swords. Manufacturers of agricultural implements are producing gun carriages and combat wagons; producers of lathes for making wooden shooting-gallery ducks are turning out lathes for army shoes; church pipe-organ makers supply wooden frameworks for military saddles. Makers of printing presses are producing the recoil mechanisms for 155-millimeter howitzers; manufacturers of vacuum cleaners are making gas masks, and specialists in adding machines are turning out shell fuses. Factories that formerly created toy soldiers and miniature trains are developing gears and canteens; troops in the field will sleep under mosquito netting furnished by firms that make ladies' underwear.

Weapons are rolling off the production lines in Government arsenals and privately owned factories. The Springfield Arsenal is making 1,560 Garand rifles a week; two years ago its production was 150 a week. One manufacturing plant is turning out an average of six light tanks a day.

Work has been started on a Government-owned, Du Pont-operated powder plant at Charlestown, Ind. Next spring it will start producing 20,000 pounds of powder a day. In 1917 the contract for our first powder plant wasn't signed until after we had been at war for seven months. A seamless-tubing manufacturer in Pennsylvania is making steady deliveries on a $25,000,000 airplane-bomb order.

Within the next month or so the Quartermaster Corps will take delivery of 5,000,000 yards of serge which will make 1,500,000 O. D. uniforms, 4,000,000 yards of heavy woolen cloth which will make 1,000,000 overcoats, and 1,500,000 yards of worsted shirting which will make almost 1,000,000 shirts for fighting men.

Work is being rushed on the Navy's combat ships now under construction. As soon as they are off the ways their places will be taken by other new fighters. The expansion of shipbuilding facilities soon will be started, to take care of both naval and merchant-ship construction.

From coast to coast the roar and clatter of machinery and black smoke belching from factory chimneys are telling the world that if any emergency arises, America will not be caught unprepared!

A worker checking fire-control instruments. To fill large defense orders, thousands of factories are turning from their peacetime products to weapons

Drs. Bodian and Howe studying microscope slides in paralysis tests

Tests on Monkeys Give New Clew to Infantile Paralysis

BECAUSE infantile paralysis leaves a pattern of inflamed tissue along nerve tracts, two scientists at Johns Hopkins University, Baltimore, Md., Drs. Howard A. Howe and David Bodian, have been able to prove that it can enter the body by several "doorways." Through experiments with monkeys, they have shown that the infection can reach the spinal cord by either the mouth or the nose.

Insane Patients Helped by Electric Shock Treatment

FIGHTING insanity with electric shock is the most dramatic recent advance in the field of medicine. At the New York State Psychiatric Institute, in New York City, seemingly hopeless cases of the most common forms of insanity, schizophrenia and dementia præcox, have been shocked back to apparent mental health by the new treatment. Electrodes, at the ends of a caliperlike instrument, are placed just in front of the ears on the patient's head. From seventy to 100 volts of current pass through his brain. The result is a violent convulsion resembling an epileptic seizure.

In some cases, a single electric shock achieves what seems to be a medical miracle, restoring the patient to sanity. Previously, insulin, snake venom, and metrazol, have been used to produce shock. The electric treatment is painless, leaves no after effects, and costs less than shock-producing drugs.

Simple apparatus for treating insanity by electric shock. At right, electrodes are being adjusted to the head of a sufferer

Balloon Flights
TRAIN NAVY AIRMEN

Ready for an ascent, Navy aeronauts take aboard a cage of pigeons to carry reports back to their base

WITH dive bombers and 400-mile-an-hour fighting planes in the headlines, few people know that the drifting free balloon, the earliest of all aids to aërial warfare, is still an essential link in America's defense program. From the field at Lakehurst, N. J., where the balloon school of the U. S. Navy is entering its twentieth year, silver-hued gas bags have traveled a total of more than 25,000 miles in training flights. Because a blimp with a disabled engine must be handled like

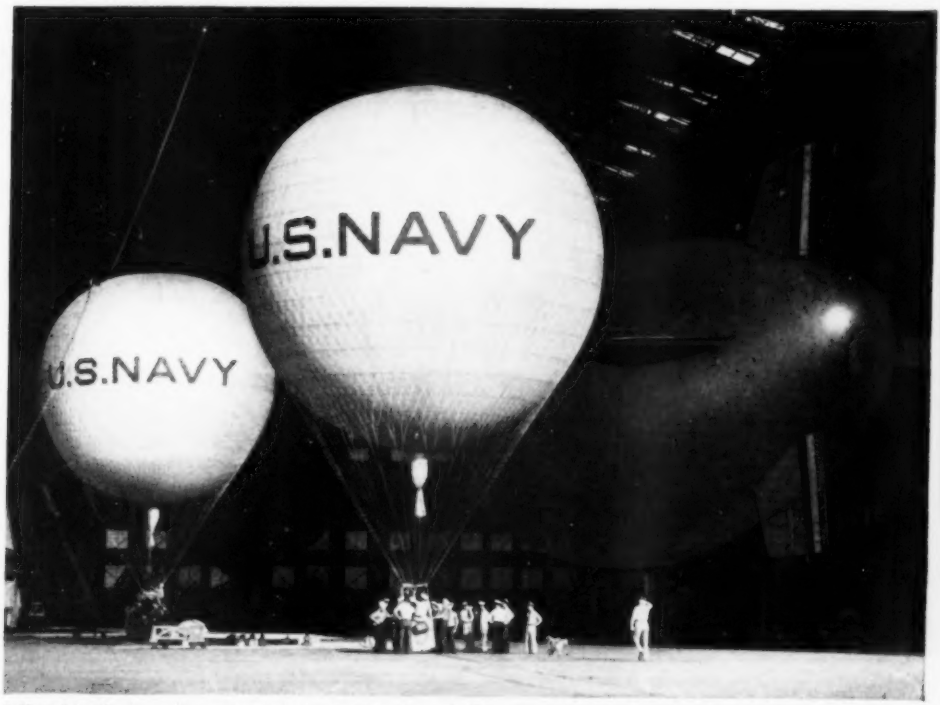
By ROBERT E. MARTIN

a free balloon, all men in the Navy's lighter-than-air service begin with a balloon course at the Lakehurst school.

The six 35,000-cubic-foot balloons used in the work are inflated with helium. As one of them is filled for a flight, the ground crew adjusts the netting carefully so the five-foot-square wicker basket is exactly centered. With as many as four students and an instructor squeezed into the basket, the ground crew "walks" the balloon, towering seventy feet in the air, out onto the field from the hangar in which it was inflated. Instruments, road maps, a woodsman's compass, and carrier pigeons are loaded aboard. Then comes the start. A shower of sand ballast, a slight upward push by the ground crew, and the great gas bubble soars away. So silently does it drift through the sky that men calling upward from the ground can be heard distinctly at an altitude of 1,000 feet.

During the first five flights, the student watches and learns. On each trip, he performs some new task in connection with navigating the balloon. To rise, he throws overboard ballast; to descend, he lets out gas through a valve at the top of the bag. Throughout a flight, there is a continual small seepage of gas so that ballast has to be discarded from time to time to keep afloat. To a balloon, ballast is what fuel is to a plane;

The start. Free balloons are directed by seeking levels where favoring winds blow



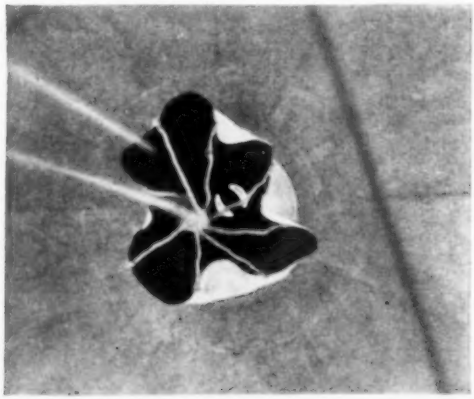
Inflated in the huge hangar at Lakehurst, N.J., these balloons are ready to be walked out by ground crews

Easing down for a landing, the basket skips through a fringe of trees before coming to rest in a field

when it is exhausted, the flight must end.

Some years ago, before helium was used in Navy balloons, Lieutenant Commander Samuel M. Bailey and two students from Lakehurst were riding under a hydrogen-filled gas bag in pitch darkness over the Alleghenies. For hours, their balloon had been losing lift. At one o'clock in the morning, Bailey decided to "settle in" for a landing. The basket was four feet from the ground when high-tension wires loomed directly ahead. Bulging with thousands of cubic feet of explosive hydrogen, the great bag struck the cables. At the same instant, both students leaped. The balloon bounced back and then shot like a cannon ball toward the sky. By hanging to the valve rope all the way up, Bailey stopped the zoom at 8,000 feet and descended unharmed on a mountaintop farm.

Overnight flights are next to the last ones made by students at the Lakehurst school. As a special precaution, the Navy sends a warning to all air-line pilots to watch out for the balloons. Two lights, a steady white one and a flashing red one, are suspended under the baskets. Both are battery-run. Because of the more even temperature at night, two bags of ballast will often carry a balloon through the hours of



Flyers leap to the ground as the bag settles with rip panel open. At upper right, a view through the "appendix" showing open valve. Right, the envelope nearly flat

darkness. On the other hand, during one day trip, Lieutenant Commander R. F. Tyler had to throw out five bags—150 pounds—of ballast from an altitude of 500 feet to keep from being carried to earth by a strong downdraft over a cool swamp a few miles from Lakehurst.

Solo flights, which end the training, are never started if the breeze is blowing faster than fifteen miles an hour, and all trips begin only when the winds blow from an easterly direction carrying the balloons inland, away from the near-by Atlantic. With the wind as navigator, carrying the gas bag in whichever direction it blows, the Navy balloon riders are never sure where they will land. One crew, last year, descended in the middle of a cemetery; another in brambles six feet high.

Whenever possible, the landing is made just beyond woods, so the trees form a windbreak. Valving out gas, the pilot brings the basket to within fifteen feet of the ground. Then he jerks the ripcord, tearing out a long panel in the side of the bag. The gas rushes out, the bag collapses, and the flight is over.

At the end of every overnight journey, pigeons are released to carry back word of the landing location, and the bag and basket are shipped home by freight. During shorter, daytime trips, a truck follows the drifting balloon to pick up the equipment and crew.

The simplest job these Navy truckmen ever had came at the end of one training flight last fall. The balloon took off in the morning and, drifting west on a sea breeze, disappeared. Late in the afternoon, it reappeared over the field, riding a wind that blew in the opposite direction at a higher level, and descended for a landing only a few hundred yards from its starting point!

In flight, altitude is gained by dumping sand ballast in bags, or from pockets on the side of the basket as above

After the landing, pigeons are released with reports to headquarters. Then the bag is carefully rolled up and placed in the basket. At the left, the balloon is loaded in the truck which has followed its flight

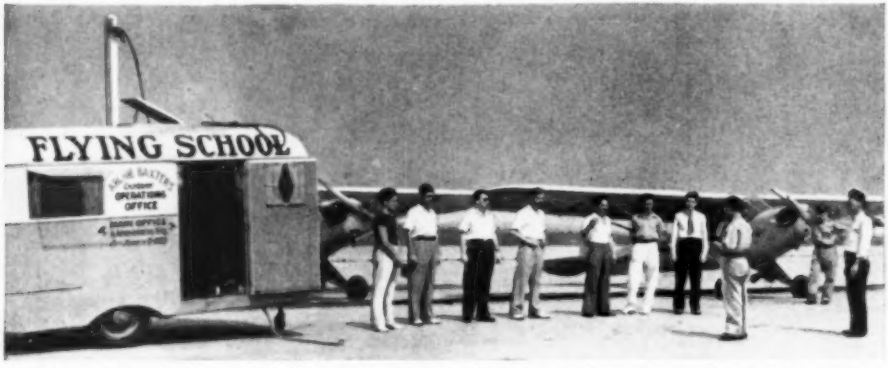
Electric Eyes Clock Plane in New Timing Device

ELECTRIC EYES replace human observers, to clock the speed of fast planes with new precision, in a photo-electric timing system perfected by a Los Angeles, Calif., test pilot. Inclosed in vertical boxes, open to the sky, the light-sensitive cells are placed at the start and finish of a carefully measured course. As the speeding plane passes over the first box, it dims the light reaching the cell, which responds by starting a stop watch. The second cell, similarly actuated, stops the watch. By comparing the elapsed time with the length of the course, the plane's speed is readily computed. A half mile suffices for the course and approach.

Planes flying over vertical boxes like the one above actuate photo-electric cells to start and stop the watch on the panel at the left

Trailer Serves as Office for Airport Flying School

TRUNDLED out on Floyd Bennett Field, New York, a rolling airport office makes a convenient headquarters for Archie Baxter, while he teaches a group of flight students what to do with a plane. Posted inside the walls of the trailer, his "orders of the day" inform his three assistants of the work cut out for them.

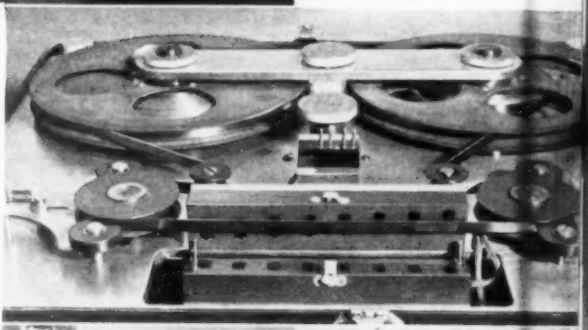


Flying students lined up in front of Archie Baxter's rolling office at Floyd Bennett Field, New York

Test-Flight Recorder Puts Sixteen Voices on a Single Tape

Words spoken into microphones anywhere in the plane by pilots and engineers are duly recorded

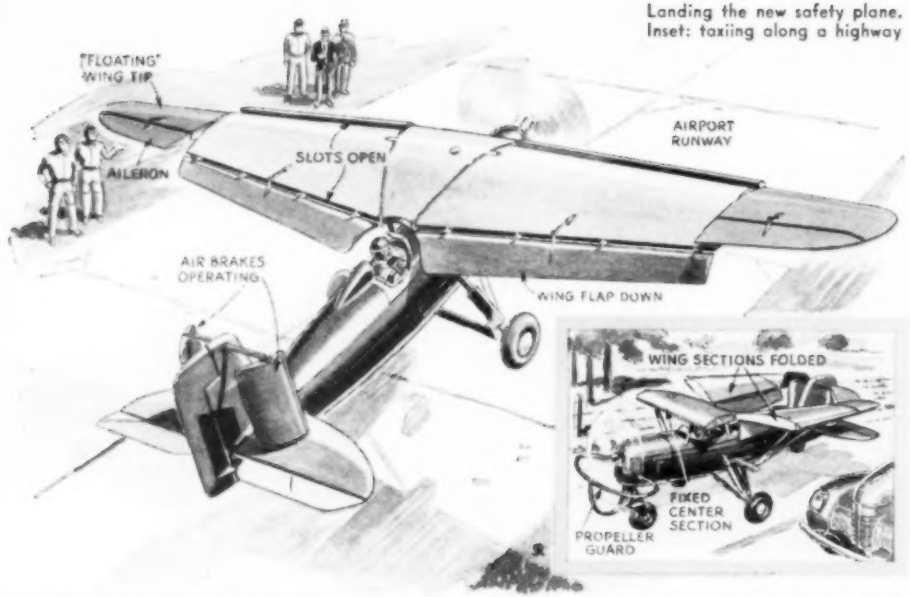
Left and below, details of recorder. Two metal tapes pass by rows of eight stepped magnets which record up to sixteen messages in magnetized lines on the two tapes. Typists with earphones transcribe messages



SIXTEEN men may talk at once, through mouth or throat microphones, into a remarkable dictating machine for use during airplane test flights. Pilots, and engineers at various stations in a plane, may thus record their observations simultaneously. Any one of the voice channels will also register mechanical vibrations occurring at the individual pick-up stations. When the plane lands, the apparatus plays back the recorded voices, which are transcribed by office secretaries wearing earphones and sitting at typewriters.

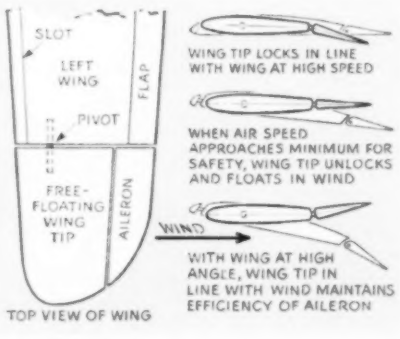
Through a standard sound-recording process, voices and noises are imprinted magnetically upon a pair of moving steel ribbons, each half a mile long and a quarter inch wide. The novelty of the new multiple recorder, devised by Herman S. Heller, of Los Angeles, Calif., lies particularly in its ability to make a single tape carry as many as eight unscrambled recordings.

Landing the new safety plane. Inset: taxiing along a highway



Floating Wing Tips Give Added Safety to Light Plane

FOR combining safety features of unusual variety, in designing a light monoplane for private flyers, Emil Doehler of Buffalo, N. Y., has won expert commendation. Vertical flaps of his own invention, flanking the rudder, supplement standard wing flaps as "air brakes." Turned inward, they help to reduce landing speed—eliminating side-slipping or "fishtailing" into a small field—and also concentrate air flow upon the rudder, so as to retain effective control. Wing slots, at leading and trailing edges, assure needed lift by providing an even stream of air over the surface. Ailerons mounted on "floating" wing tips, which line up with the wind like weathervanes, give full response at angles of attack large enough to make ordinary ailerons ineffective. After a three-point landing, using a tail wheel, the craft settles forward upon a tricycle landing gear and wheel brakes bring it to a quick stop. Hinged wings will swing back against the fuselage, to reduce the cost of rented hangar space. In bad weather, a pilot could make an emergency landing on a highway, fold the wings, and drive away. Because of the roadability of the machine, the designer has added a propeller guard.

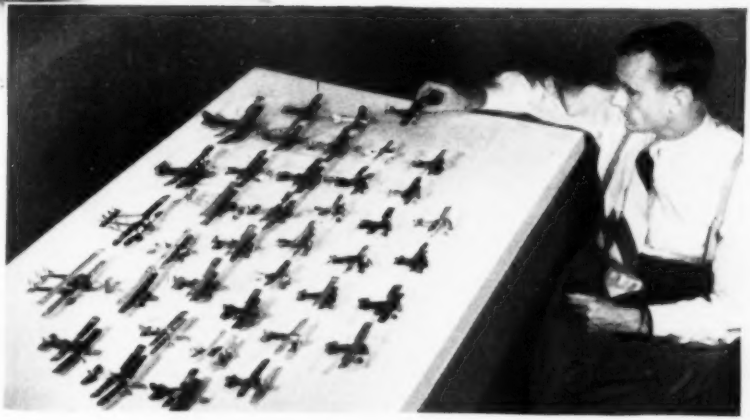

SLOT
LEFT WING
FLAP
PIVOT
FREE-FLOATING WING TIP
AILERON
TOP VIEW OF WING
WING TIP LOCKS IN LINE WITH WING AT HIGH SPEED
WHEN AIR SPEED APPROACHES MINIMUM FOR SAFETY, WING TIP UNLOCKS AND FLOATS IN WIND
WIND
WITH WING AT HIGH ANGLE, WING TIP IN LINE WITH WIND MAINTAINS EFFICIENCY OF AILERON

How ailerons on "floating" wing tips give full effect with the wings at any angle

Drawing at left shows how plane lands on tail wheel, taxis on its tricycle gear

Table-Top Armada Shows Famous World-War Planes

A TABLE-TOP air fleet of midget fighting planes, representing most of the aircraft used in the first World War, has been assembled by Allan F. Kitchel, Jr., of New York City. All of the models have been constructed to the same scale, one eighth of an inch to a foot. The first plane Kitchel built was a miniature reproduction of Von Richthofen's famous Fokker triplane. This and later models were all created with wooden bodies and wings carved with a jackknife and razor blades, while the "flying wires" were added with a needle and thread. To hollow out the cockpits of the midget planes, Kitchel used a heated nail.



A Handley-Page bomber dating from World War No. 1. Landing gear did not retract

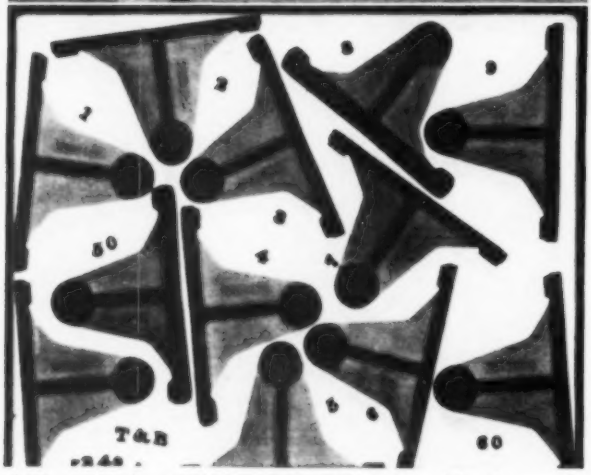
Allan Kitchel poses beside his carefully modeled collection of historic planes

Lie Detector Tests Emotional Make-Up of Air-Line Pilots

How a prospective pilot is tested for various emotional reactions

TO DETERMINE the emotional stability of prospective pilots, American Airlines has begun making tests with the lie detector, a delicate electrical apparatus developed for use in criminology. After electrodes are strapped to the hand of the subject, minute variations in body current are noted as the test, placing the prospective pilot in various emotion-producing situations, progresses. A record of these variations in body current enables the operator to obtain a picture of the emotional make-up of those applying for positions as pilots.

X-RAY MACHINE SPEEDS



Radiograph of small airplane parts, each numbered for the record. Above, feeding a long structural member through the X-ray machine

TO DETECT invisible flaws in airplane fittings, Tom Triplett and Victor Barton have X-rayed 1,000,000 parts during the last five years, in the Lockheed plant at Burbank, Calif. This year, alone, they expect to equal or exceed that figure. What makes the speed-up possible is an automatic X-ray machine they have developed, capable of exposing 114 sheets of fourteen-by-seventeen-inch negative every minute. A marvel of mechanical precision, it adapts assembly-line technique to what has hitherto been a time-consuming bottleneck in production. Ten of the devices, it is estimated, would make all necessary radiographs for America's goal of 50,000 planes a year!

Standing ten feet high and four feet square, the big X-ray machine handles the largest airplane castings made. Open gates, on each side of its cabinet, permit making section-by-section "panoramas" of fabricated pieces up to two feet wide and thirty feet long. Dozens of smaller parts may be X-rayed at once. If stepped-up production of transports and bombers demands a higher tempo than is possible by hand feeding, a continuous conveyor belt will carry the parts to the apparatus.

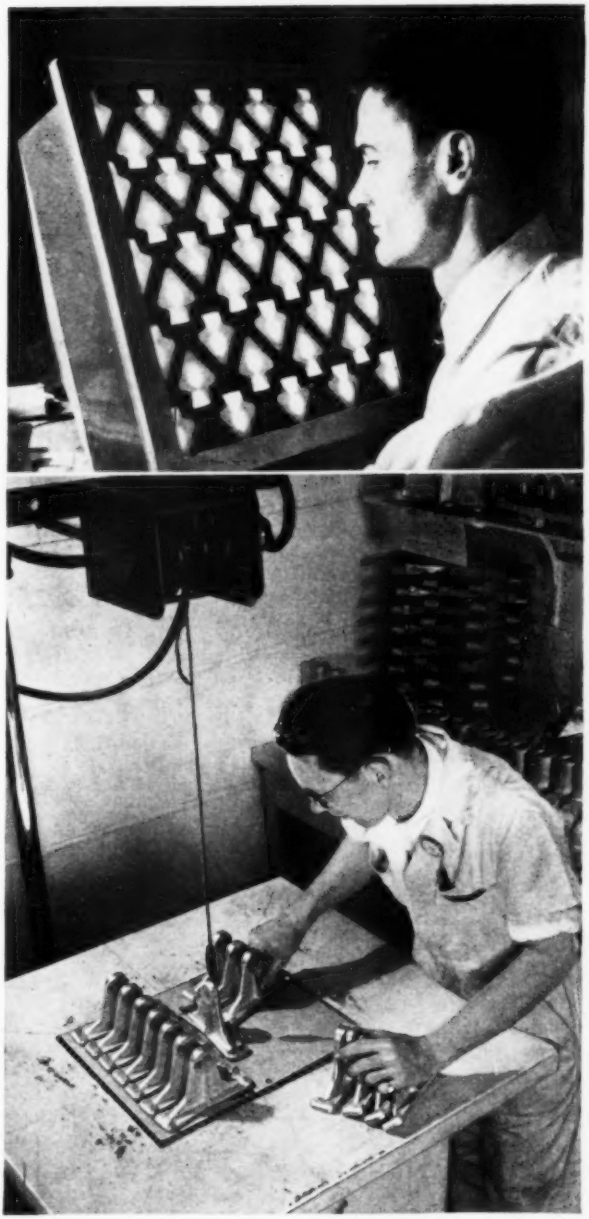
Shielded from the dangerous rays by 1,500 pounds of lead that sheathes the cabinet, the operator stands alongside the machine. Once he has preset its controls, for the desired exposure and rate of feeding, he can devote all his attention to getting parts on and off the conveyor. If the powerful X-ray tube within the cabinet burns out, it can be replaced in sixty

UP PLANE PRODUCTION

seconds. An electric lift raises and lowers the housing, and the tube plugs directly into its transformer, eliminating high-voltage cables.

As intently as a surgeon would study an X-ray of his patient, experts examine the developed pictures of the castings in illuminated viewers designed especially for the purpose. If a part is of uniform thickness, and contains no defect, it will give a "shadowgraph" of perfectly even grayish tint. Let there be such a flaw as an air pocket or a cavity caused by internal strains, however, and the X-ray "fingerprint" promptly reveals it. Since the rays pass through less thickness of metal at this point, they give a stronger impression, leaving a spot of different tint on the picture. Even in views of castings of irregular thickness, where some parts naturally appear blacker than others, the engineer's trained eye instantly spots any telltale blemish in the X-ray impression. Since every part is numbered for identification, any offending one may speedily be traced and discarded, saving lives that might be risked by its failure in flight.

For fittings that pass the test, the identification numbers enable a record to be made of the plane into which each one goes. Thus a continuous history may be kept of the performance of all "stress parts," the hidden but vital elements that bear the strain of banking, diving, and twisting in modern aerial combat. If one of them fails in action, its X-ray record can be checked and the spot where failure occurred can be studied for redesigning.



Centering castings to be photographed. In the upper picture, an X-ray technician is hunting flaws in a negative showing forty-one parts

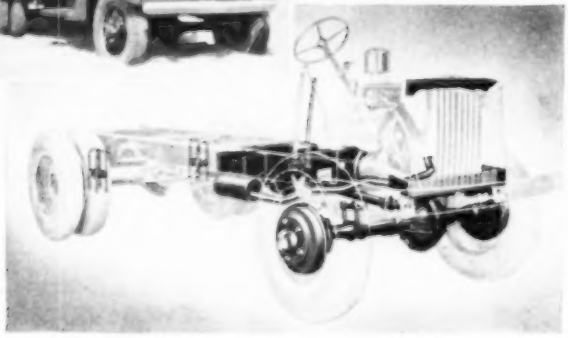
Life-Preserver Coat Keeps Man Afloat

Testing the life-preserver overcoat proposed for British tars. Left, coat in regular use

A LIFE-SAVING overcoat, declared capable of keeping four men afloat, has been submitted to the British Admiralty by an English inventor. Beneath its gabardine exterior, the garment is lined with a material six times as buoyant as cork. In consequence, it is reported to weigh less than half as much as the present service great-coat, while it is also many times warmer, owing to its heat-insulating qualities. Thus the life-saving device not only conforms to government specifications for wearing apparel, but also offers increased comfort, together with its service in a sea disaster.

Conversion Unit Gives Motor Trucks Four-Wheel Drive

A truck converted for four-wheel drive. The view below shows installation of unit



HEAVY GOING becomes easy for motor trucks, when a new conversion unit transforms them from two-wheel to four-wheel drive. To make the change, an auxiliary transmission is installed, and a new front axle, with a universal joint and special steering ends, is substituted for the old one. The resulting four-wheel traction enables trucks to wallow through mud, sand, brush, or swamps, negotiate soft cuts and fills in road-construction work, and enter and climb out of excavations. On paved highways, covered with snow or ice, it gives more even traction and greater security at curves or hills.

Cellophane Covering for Model Plane

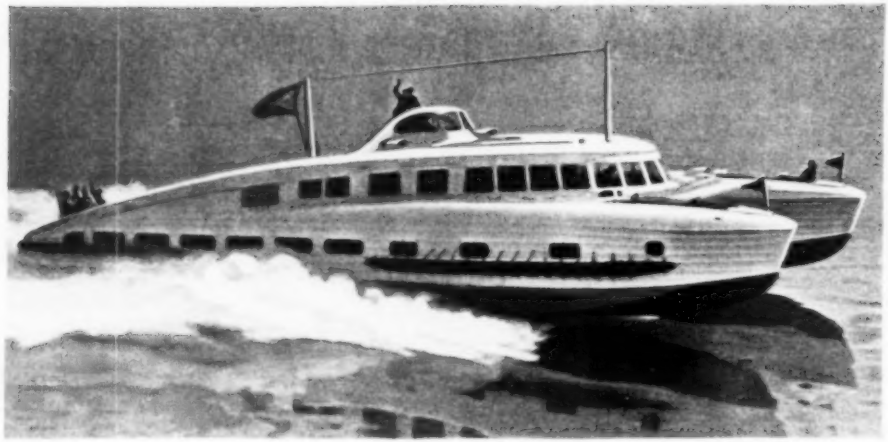
THIN sheets of cellophane, held on with model-airplane cement, form the covering for a model plane built by Jack Schieder, of Trenton, N. J. Revealing the workmanship within the wings and fuselage, the covering, shrunk tight by a steam bath, also provides an ideally smooth surface for the gas-powered model. Neat repairs are quickly made on the covering by patching on strips of transparent Scotch tape.

The transparent covering shows up the plane's construction

Boy's Midget Tractor Is Just Like His Dad's

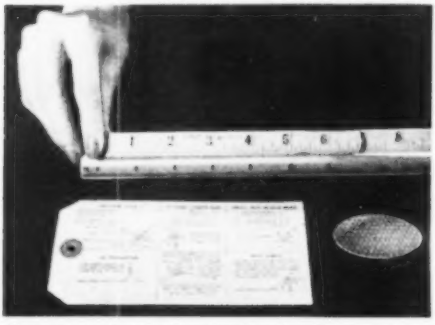
WHILE Marcus Ming, Sr., a Mississippi county-road superintendent is towing heavy machinery with his huge track-type tractor, Marcus, Jr., is usually at home towing his playmates' wagons here and there with his own 1½-horsepower working model of his dad's juggernaut. Father, son, and machines are below.

A 1½-horsepower gas engine drives the tiny tractor's treads through a train of gears and separate clutches



Twin-Hulled Passenger Cruiser Hits 50 Miles an Hour

HURTLING across the waters of the western shore of the Black Sea at fifty miles an hour, the twin-hulled, streamline craft pictured above carries passengers, mail, and express in a recently inaugurated service between Sochi and Sukhum, in Soviet Russia. Planing the entire distance on its novel W-shape bottom, the express cruiser boasts a commodious cabin straddling the two hulls, and open cockpits fore and aft.



The tag has instructions for bending the new pipe

Division Marks on Steel Pipe Make It Easy To Measure

STEEL TUBING of the rigid-conduit type used to carry wires close to machinery and fuse boxes, or down the sides of houses from overhead lines, is now available in ten-foot lengths marked in inches and feet to facilitate cutting it into desired sections. Special directions for bending the pipe are furnished on a tag which also carries a chart to show instantly the length of pipe taken up by each bend. The interior of the pipe has novel raised and rounded knobs that make it easier to slide wires through.

Using this applicator, gummed tabs can be stuck to notebook pages five times as fast as without it

Gummed Rings for Notebooks Come in Handy New Form

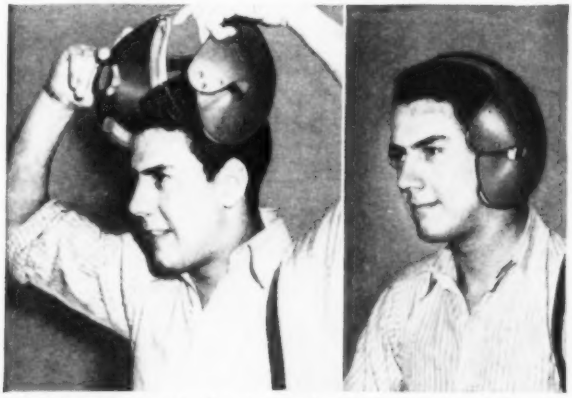
GUMMED reënforcements or tabs for the holes in the pages of loose-leaf notebooks are now being furnished in stacks like doughnuts on a stick to facilitate attaching them. As shown in the illustration at the left, renewal packages of the tabs come ready stacked for placing on the applicator. In use, the bottom tab is dampened and the applicator pressed against the page. The gummed tab is left sticking to the page when the applicator is lifted, and the next sticker is immediately ready for attaching. Much time may be saved with the device.

Robot Observer Radios Report on the Weather

NO WEATHER MAN need tend the compact observatory pictured at the right, for electric attachments interpret the readings of its numerous instruments, and an automatic radio transmitter puts them on the air. Receiving stations thus obtain complete information on the air temperature, barometric pressure, relative humidity, speed and direction of wind, and rainfall at the observation post. Developed by Wilbur S. Hinman, Jr., of the National Bureau of Standards, the robot stations are especially suited for remote or hard-to-reach locations, where the maintenance of meteorological observers would entail physical hardships or undue cost. A trial installation at Washington, D. C., pictured at right, is reported to have given thoroughly satisfactory service in exacting tests. Because of the simplicity of the mechanism, there is little about it that can get out of order.

Automatic stations like this report weather conditions by radio

Ear Pads Protect Baseball Batters from Wild Pitches



Slipped on like a pair of radio earphones, the new baseball safety pads protect the sides of the head when the player goes up to bat

"EAR MUFFS" for baseball players are urged by Ford Frick, president of the National League, to guard batters against injury from pitched balls. Made of rubber and leather, the twin pads are joined like the earpieces of a telephone headset, and as easily slipped in place, as shown in the illustrations at the left. Their generous proportions afford nearly complete protection for the head as the batter faces the plate, while apertures permit perfect hearing. Despite their effectiveness, the lightweight guards are said to be no hindrance to the players.

One man can wheel the welding machine wherever it is needed

Two-in-One Welder Rolls Up to Its Job on Pneumatic-Tire Wheels

EQUIPPED with two welding guns, a new shop outfit eliminates the need for duplicate equipment. Instead of requiring work to be brought to it, the unit rolls on pneumatic-tire wheels to the location of the job. Necessary connections for air, water, and power can instantly be made. A single transformer operates both welding guns, and the transformer and gun jaws are water-cooled.

New Enamel Gauge

RECENTLY developed by engineers of the General Electric Company at Schenectady, N. Y., a new electric gauge indicates differences as small as a ten-thousandth of an inch in the thickness of porcelain-enamel applications. The gauges have proved particularly useful in the manufacture of refrigerators, stoves, and other enamel ware.

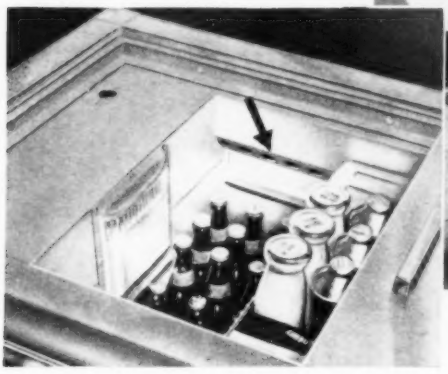
Piano Keyboard Replaces Mallets for Playing Vibraharp

A PIANO keyboard takes the place of hand-held mallets to play the "vibrachord," latest addition to the xylophone family of musical instruments. Depressing each key closes an electric switch and actuates an electromagnetic hammer that strikes a blow against the corresponding metal tone bar. Separate switches control a vibrato-resonating effect. The inventor, an orchestra leader, created the novel instrument by remodeling a standard one for which he could find no player. Now his wife, a pianist, plays it in his band.

Called a "vibrachord" by its inventor, the instrument has a 2½-octave keyboard that actuates magnetic hammers to strike the bars. Right, folded for carrying

New Bottle Cooler Substitutes Cold Air for Ice Water

TO DISPENSE bottles free from dripping moisture, a new electric-powered beverage cooler substitutes a blast of cold, dry air for a tank of ice water. Wire dividing racks, within the refrigerated cabinet, serve to segregate various brands of drinkables, or to designate the warm bottles last added to the box. Opening the top automatically turns on a light that illuminates the entire compartment. When in place, the stainless-steel sliding top may be used as a counter or serving stand.



The arrow points to a row of air ducts from which cold air flows from the cooling unit. A sliding top gives access to the bottles

Children's "Tummy Desk" Satisfies Their Yen To Sprawl

CATERING to children's quaint ideas of comfort, a manufacturer has introduced a "tummy desk" for those who like to do their lessons on the floor. It may also be used on a table top, where its rubber feet prevent it from marring the finish. When short, detachable legs are made fast, it becomes a useful bed desk for children or adults. Beneath the hinged top is ample storage space for books, pads, and pencils, while a removable bracket at the back holds a large roll of scrap paper for scribbling.

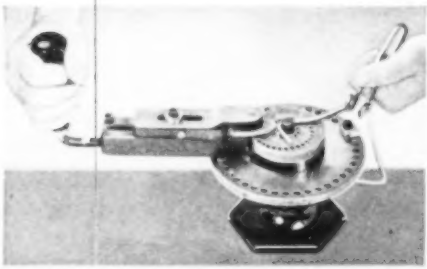
Two uses of the desk designed specially for children. With legs removed, it may be placed on the floor as at the left. At the right, the short legs are attached and it becomes a desk for working in bed

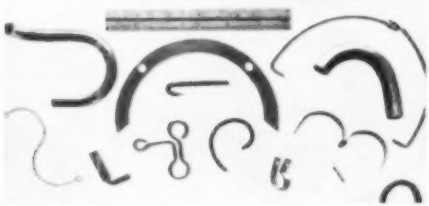
Electrical Attachment for Piano Plays Instrumental Solo

Playing a piano fitted with the new solo attachment. Electric parts are concealed beneath the piano

Stops on the special keyboard below give the solo part a tone quality like that of various instruments

FITTED to any piano, a new attachment makes it sound as if two musicians were playing—an instrumental soloist and a piano accompanist. To render the melody, one note at a time, the player uses a bank of thirty-six keys mounted beneath the regular fingerboard. Organlike stops give this solo part the tone of brass, wood-wind, or stringed instruments at will. Meanwhile the performer fingers the accompaniment upon the usual keys. A knee lever controls the volume of the solo tones, which are produced in vacuum tubes and made audible by a compact loudspeaker. With the attachment at one end of the keyboard, two persons can play a duet.

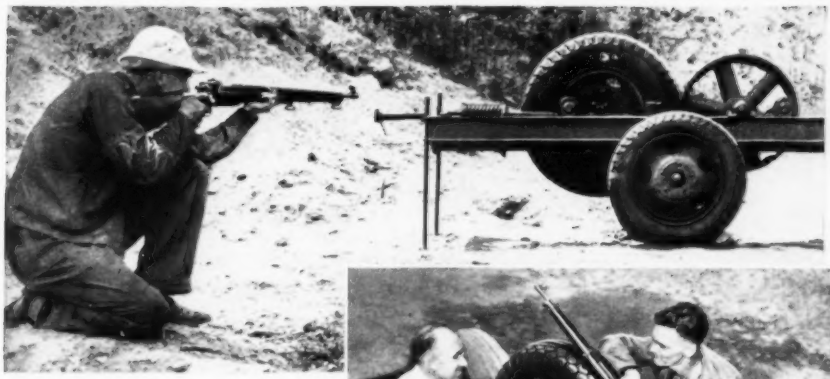




The hand bending tool in use, and some of the parts made with it. A six-inch rule gives size comparison

Novel Hand Bending Tool Shapes Metal Accurately

TO AID in filling small orders of from fifty to 300 duplicate parts, without the trouble and expense of making forming dies, a Minneapolis, Minn., mechanical-products firm sought a universal hand forming machine. Finding none on the market, its craftsmen designed and built one of their own. When neighboring shops clamored to borrow or rent the original model, the Minneapolis concern decided to manufacture it, and now it has become one of their leading products. A precision bench or vise tool, it bends round or square rods and tubes, wire, and strip stock to curved or irregular shapes, with 1/1,000th-of-an-inch accuracy and much saving of material.



Examining a tire after rifle bullets had been fired into it, as shown above, in tests at the Aberdeen, Md., proving grounds

Bulletproof Tire Heals Own Wounds in Army Tests

FIRED point-blank into the tread of a new military tire, bullets from army rifles and machine guns recently provided a spectacular demonstration of the ability of newly devised, triple-layer inner tubes to seal themselves when punctured. The tires, developed for use in the United States Army by laboratory workers in Akron, Ohio, are expected to prove valuable on gun carriages, antiaircraft gun mounts, and machines of motorized cavalry. Three layers of special rubber compounds, one of which is semiviscous, give the new tires their ability to "swallow bullets" without being punctured. The inner tubes formed of these layers seal themselves without appreciable loss of pressure when they are pierced by bullets. At the famous Aberdeen proving grounds, in Maryland, Army officers fired .50 and .30 caliber bullets into the tires. One tire, pierced by .50 caliber machine-gun bullets, continued in service for 200 miles without additional inflation.

Latex Injection Kit Repairs Leaks in Ball Bladders

WITH a compact repair kit just introduced by a Los Angeles concern, anyone can repair small leaks in beach balls, basketballs, and footballs. The kit consists of a tube of specially compounded liquid latex and a hollow needle through which the fluid is forced into the interior of the bladder. The latex is reported to seal a small puncture in a few seconds. The whole job of repairing a punctured bladder is said to be accomplished in about one minute. As soon as the latex has had time to fill the hole, the ball is as good as new and can be pumped up and put into use again.

A hollow needle is used to force latex into the bladder

Paint Mixer for Stores Blends Colors To Suit Buyers

This device mixes blending hues with the paint in a can

CUSTOM-MADE paint, of any tint that a customer may fancy, can be obtained from stores using an ingenious new mixing system. A dealer need keep in stock only a few standard colors of "base" paint, in cans. These are supplemented by cartridgelike tubes containing blending hues. Without removing the main lid of the special can, the contents of any cartridge may be injected through a small auxiliary opening, and an electric agitator thoroughly mixes the blend in two minutes' time. Thus a shopkeeper can offer a selection of several hundred colors, while keeping his store space and inventory to a minimum.

Synthetic Glycerin

GLYCERIN, commonly obtained as a by-product of the soap industry, can be produced in sufficient quantities from petroleum to meet any wartime requirement, according to chemists of the Shell Development Company.

New Slot Machine Shows Sound Films

SOUND-MOVIE cabinets, operated by dropping a coin in a slot, and quickly installed anywhere, offer a new form of entertainment for railroad stations, lunch rooms, and other public places. Sponsors of half a dozen makes, already in use or nearly ready for production, expect them to compete in popularity with the coin-operated phonographs now in vogue. A typical model is shown at right, with James Roosevelt, son of the President, watching one of the reels his film company has made for it. Using sixteen-millimeter film, it presents a three-minute program, the pictures being projected on a small screen at the front. One maker proposes a more ambitious sort of installation. From a suitably located cabinet in a restaurant, a system of mirrors would convey the images so that they could be viewed by occupants of every booth in the establishment.

James Roosevelt viewing pictures on a new "Talkie" automat

The Man

with the Net

FILES *of the Federal Bureau of Investigation contain 250,000 nicknames used by criminals. They range from "Carbolic Kid" and "Izzy the Eel," to "Slow Town Blackie" and "Boo Boo Hoo Hoo."*

ADDERS *have an antidote for their own poison in the bile of their gall bladders.*

DESERT TURTLES *of the Southwest sometimes swallow enough water in a single drink to increase their weight forty percent.*

ICE-CREAM *factories in this country use more milk annually than 1,000,000 cows can produce.*

KING CRABS *have blue blood.*

HORMONE SPRAYS *now prevent apples from dropping from trees before they are ripe.*

CARBONATED *soft drinks were used in America as early as 1807.*

RATTLESNAKE-SKIN *neckties are being sold in a Broadway store in New York City.*

CARRIER PIGEONS *with a natural camouflage of mottled plumage are being bred for wartime use.*

SYNTHETIC RESIN *made from cactus is a new product reported from Mexico.*

GASOLINE *has an explosive power more than eighty times that of dynamite.*

RACE HORSES *in the United States are not permitted to have more than fourteen letters in their names.*

Kitchen Utensils Lend a Hand in Odd Music of Cowboy Band

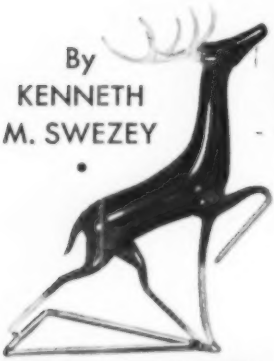
Coaxing a tune from a cheese-box violin and, below, a washtub bull fiddle

RESIDENTS of Yermo, Calif., dance to the wailing and thumping of strange instruments in the hands of a five-piece cowboy orchestra. With a bent arrow and string for a bow, one performer plays a "violin" made from a cheese box. Another alternately bows and thwacks a "bull fiddle" constructed from a washtub, a string, and a broomstick. By pulling against the stick he obtains a variety of more or less musical tones.

Here's the full orchestra. Eliminating the piano, how many familiar articles do you recognize in it?

Robert Howell begins a delicate piece of Bohemian glass blowing by softening a tube of colored glass. His wife holds a pine block to reflect heat of gas flame

After drawing out the tube at both ends to facilitate blowing, the artist makes a small bubble at one end



By
KENNETH
M. SWEZEY

Glass-Blowing

BLOWING bubbles in glass has brought international fame, as well as a modest fortune, to the Howell family, of Union, N. J. Touring the length and breadth of the United States, in a housecar containing a complete glass-working shop, they have given thousands of demonstrations before colleges, schools, and clubs, of a delicate and beautiful art that dates from before the

By drawing out the white glass, the ears and antlers are given the desired shape. Howell now adds the tiny prongs to the horns by the use of more white glass

A leg is attached in the same manner as the horns. Extreme heat causes the red of the body to mix with the white of leg

As the bubble is stretched, it begins to take shape as the neck of a graceful figure of a deer. Head is formed by pulling

To make the ears and antlers, a rod of white glass is heated and touched to the sides of the head. Howell keeps on blowing to prevent the head from collapsing

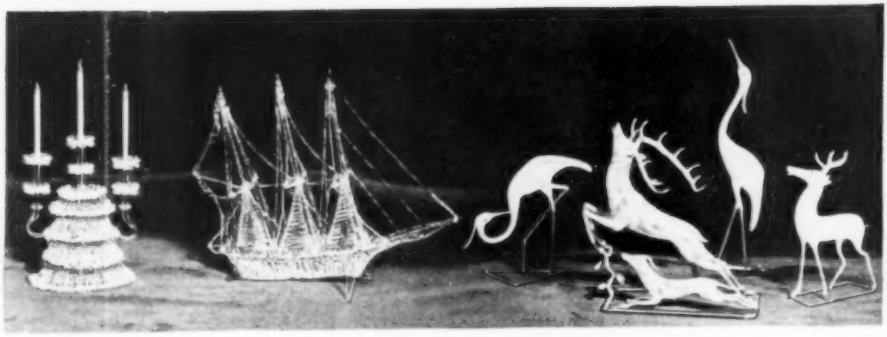
Family WINS FAME IN ANCIENT ART

beginning of the Christian Era. When they are not traveling, the Howells work long hours over hot gas fires in the cellar of their New Jersey home, creating vases, animals, birds, flowers, and other decorative knickknacks of glass, to fill waiting orders from all over the world.

Robert Howell, the father, began his glass-blowing career in his own home, when he was in his teens, blowing thermometer bulbs and laboratory equipment which he sold to a chemical-supply house. Soon he was engaged to demonstrate glass blowing to crowds at the Chicago World's Fair of

After adding a tail, Howell examines the legs carefully to make sure that the figure will stand properly. The next step will be to pull off the long nose

A triangle bent from crystal rod is fused to the feet to serve as a base. The completed figure is seen on the opposite page



"Crocheted" glass candelabra and ship model made by Mrs. Howell, shown at work at the right. Upper right, examples of Bohemian glass blowing done by the Howells

1893. When he married, his wife also learned the art, and the two went forth as a glass-working team. Then came the children — two girls and two boys — and each, of course, became a glass blower. During forty-six years of exhibition, including a spectacular engagement at the 1939 New York World's Fair, the Howells have instructed and fascinated literally millions of persons in the secrets of this ancient art.

The Howells specialize in Bohemian glass blowing, so called from the fame given it by the craftsmen of Bohemia. It consists in shaping all sorts of delicate objects from thin glass, with the use of only the simplest tools, and without any kind of molds. Original stock comprises glass tubes and rods, of various sizes and many brilliant colors. One of the most expensive types of this glass is the beautiful ruby glass, which owes its color to a salt of pure gold.

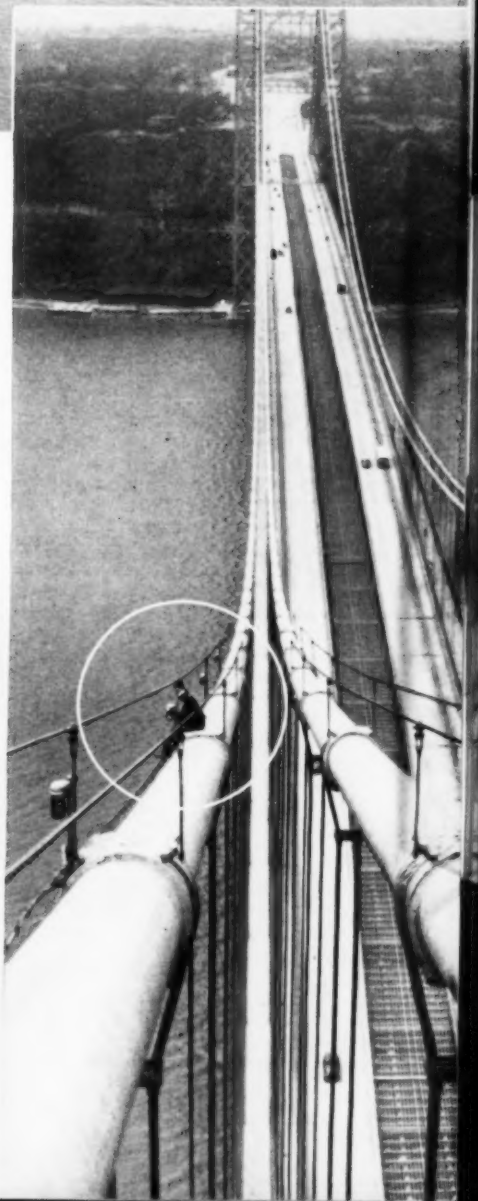
Besides skill and a keen artistic sense, the chief requirement is a hot, steady, and sootless fire. Howell's fires come from specially built gas burners, fed with air from a motor blower and capable of producing a temperature above 3,300 degrees Fahrenheit. In working large pieces, the heat is concentrated by using reflecting blocks of white pine.

All blown work begins with a tube of glass of the desired color and size. This is heated to the required softness—determined by the feel and color of the glass—and is expanded by blowing gently into it, and lengthened or contracted by drawing it out. Beauty and elaborateness of a piece are determined only by the skill and imagination of the worker.

"Crocheted glass" is a special type of glass working that has been developed to a high degree of perfection by Mrs. Howell. Pieces of this work, ranging from little glass baskets and candlesticks to elaborate candelabra and model sailing ships, are built up, loop by loop, with "yarn" drawn from the end of a rod of crystal glass.

Bridge's 2,700 Lights Keep This Man Busy

COMBINING the jobs of human fly, electrician, and lamplighter, John J. Kiernan watches over the 2,700 electric lamps which light the great George Washington Bridge across the Hudson River. In his work of inspecting equipment and replacing burned-out bulbs, he climbs cables, rides along wires in a bo'sun's chair, dangles high above the river, at times more than 500 feet in the air. His day begins with an inspection of the aircraft warning lights at the top of the great towers; it ends with an examination of the countless navigation lights dotting the anchorage piers. In between, the steel-nerved Kiernan walks miles uphill and down on the monster metal cables which support the 3,500-foot span. To guard against sudden gusts carrying him from these gigantic tight ropes, he loops a safety belt over outrigger cables, sliding it along as he advances. A veteran "steeple-jack electrician," Kiernan has been keeping the bridge lights burning since 1931.



John J. Kiernan dons his safety belt for his daily inspection of the lights on the George Washington Bridge. The other views show him at work on huge cables high above the Hudson River

Violins FROM SCRAP WOOD

Samuel Stochek marking a piece of salvaged wood which will eventually become part of a fine violin. A standard form is the pattern

BEAMS, doors, and shelves from old houses supply Samuel Stochek, New York violin maker, with raw material for a fascinating craft. His skilled workmanship transforms the seemingly worthless bits of lumber into exquisite hand-made violins, valued at up to $1,500 apiece!

As a "buff" follows fire engines, so Stochek trails wreckers demolishing outdated buildings. Friends help keep him informed of fresh hunting grounds. His object is not primarily to save money, for in these places he finds the kind of lumber he likes best. After fifty years or more of seasoning, the wood is just right.

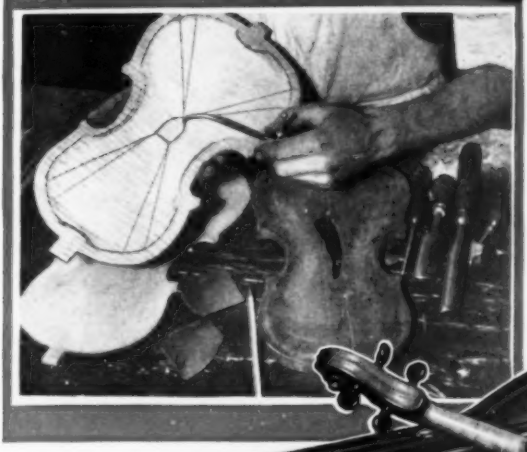
A lucky collecting trip to some half demolished house may yield him a perfect slab of quarter-cut, flame-grained maple, which will make an ideal back—the resonating part—for a fine violin. Other game includes spruce for the top, or sound board. Armed with a knife and plane, Stochek probes each likely-looking piece to test the cut, color, and grain. If the wood is yellow on the outside, but white underneath, it has not aged sufficiently. Deep penetration of the surface color indicates long seasoning. Shavings of old wood, crushed in the hand, disintegrate into fine fragments; newer wood is more cohesive. Too fine a grain will make for undue loudness, while grain that is too wide will detract from brilliancy of tone.

Back in his shop with his trophies, Stochek begins the task of shaping the pieces. Delicate gouging and planing, constantly checked with calipers, thins a curved back until it is slightly transparent when held to a strong light. A single one of these pieces may take him a month to complete. Other parts are assembled and, after numerous coats of special varnishes and stains, the violin is ready for use.

Searching old houses for good wood, he tests likely-looking pieces with a knife and plane

Stochek himself plays the violin ably, but he likes even better to make one. It gives him a thrill to fashion, from a floor joist that has resounded to the steps of thousands of people, a beautiful instrument that can sway the emotions of other thousands.

Raw material and finished product. This beautiful instrument was made from wood like the pieces on the workbench. At the left, calipers are being used to gauge the thickness of a partly finished back



The violin below is valued at $1,500. Notice the beauty and straightness of the flame grain. Yet all the wood came from a building that was being wrecked

WHERE HEALTH IS

A scene in A.G. Balfour's laboratory at Englewood, N. J., where medicinal juices are extracted from strange sources

℞ SIX OUNCES of grass juice. Prescriptions such as that are all in the day's work for Abraham G. Balfour. Fresh bottled grass juice, which is said to vie with spinach as a source of calcium and vitamins, is but one of more than 700 varieties of fruit and vegetable juices and their blends which he produces in his Englewood, N. J., laboratory. His unique factory is running twenty-four hours a day, and shipments of choice garden and orchard products from as far away as California arrive at Englewood on a daily schedule.

Balfour's unusual business began five years ago. A dietician engaged in vitamin research, he became interested in the possibilities of obtaining concentrated vitamin fluids from various plants and fruits. Special machines, such as a whirling plate that cuts vegetable pulp into shreds one ten-thousandth of an inch thick, and a press which squeezes out juice with a pressure of eighteen tons, have been developed for the work.

Among the most popular products of the Englewood laboratory, in addition to grass, banana, watercress, carrot, and spinach juices,

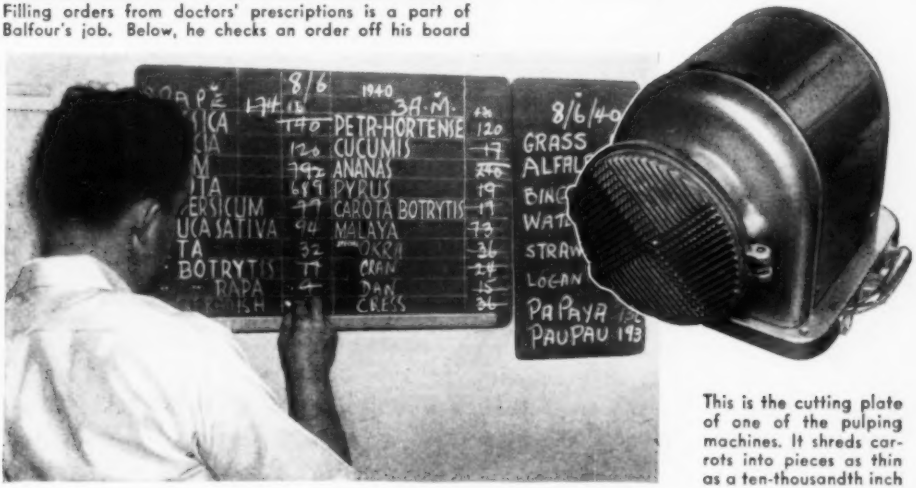
Here Balfour is pressing juice from a tropical fruit resembling a banana. It takes sixty of these little fruit to make twelve ounces of juice. At the right, alfalfa is being cut up in preparation for use

PUT UP IN BOTTLES

are a combination of tomato and horse-radish juices and a blend of the fluids squeezed from celery and timothy hay. In various ways, by-products of the laboratory are turned to profit. Orange peels are candied; celery hearts are sold to local restaurants; cherry skins go to chewing-gum manufacturers who obtain from them a waxlike preservative. Customers even from abroad send for Balfour's "vitamin juices." One man, in Zurich, Switzerland, recently ordered a bottle of his favorite juice sent across the Atlantic by Clipper plane. The cost was one dollar for the juice and $9.70 for express.

After preparation, juices are placed for a time in this refrigerator cabinet. All orders are delivered promptly to insure freshness

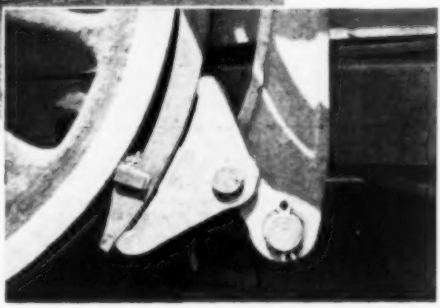
Filling orders from doctors' prescriptions is a part of Balfour's job. Below, he checks an order off his board



This is the cutting plate of one of the pulping machines. It shreds carrots into pieces as thin as a ten-thousandth inch

Locomotive Tires Reshaped Without Removing Wheels

A winch tows the locomotive backward while cutting tools turn down its tires to reshape the worn spots



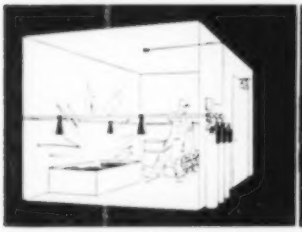
Oversize blocks replacing brake shoes hold the lathe-type tools

LOCOMOTIVES no longer need be stripped of their driving wheels, in a new time-saving method for reshaping flat and worn spots. Instead, brake shoes are replaced by oversize blocks which hold lathe cutting tools against the metal tires. A winch then slowly tows the locomotive backward along the track by a strong cable, while the tools do their work. At frequent intervals, tests with calipers show the progress made.

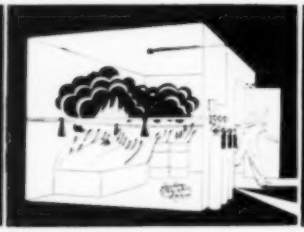
Tried out successfully on heavy mountain locomotives, the scheme is said to have greatly reduced the period during which an engine must be laid up for repairs. Formerly it took a week or ten days to dismantle the drivers, remove the tires, turn each one to size and roundness in a wheel lathe, and restore the locomotive to service. Now only a small fraction of this time is required at a great saving in cost as well.

Factory "Sprinkler" System Uses Carbon Dioxide Gas

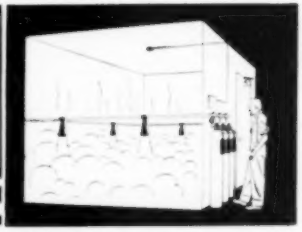
USING carbon dioxide gas instead of water, a radically new "sprinkler" system automatically smothers fires in rooms where gasoline, naphtha, oil, lacquer, or enamel is handled. Employes have only to rush to safety, leaving the fire-fighting job to sensitive heat detectors that open the gas valves. In pioneer installations designed by Walter Kidde & Co., of New York, nozzles may be located over small tanks, or a whole room may be flooded with gas, as doors and windows shut automatically.



A "flash fire" starts in a factory room where inflammable liquids are handled. Note nozzles

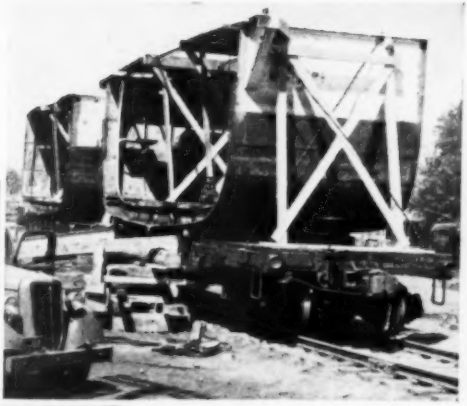


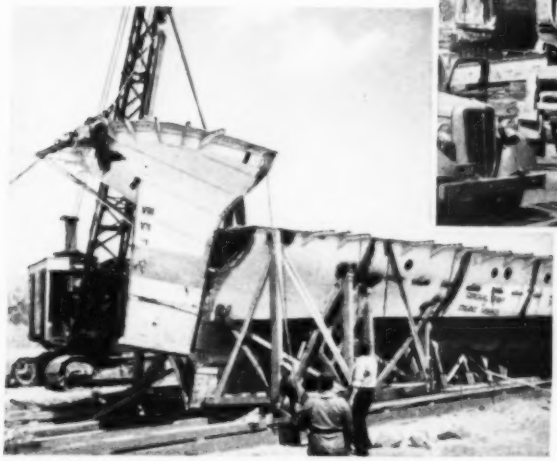
The workman leaves the room, as heat automatically releases gas kept under pressure in cylinders



Billowing from nozzles, carbon dioxide smothers flames. Doors and windows close automatically

Cut into Ten Sections, Boat Voyages Overland on Railroad Flat Cars



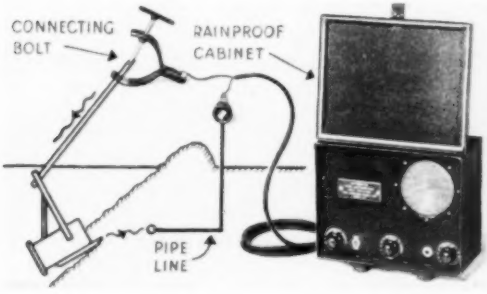


Sections of the "Mount Washington II" on flat cars for shipping. The vessel is being put together again in view at left

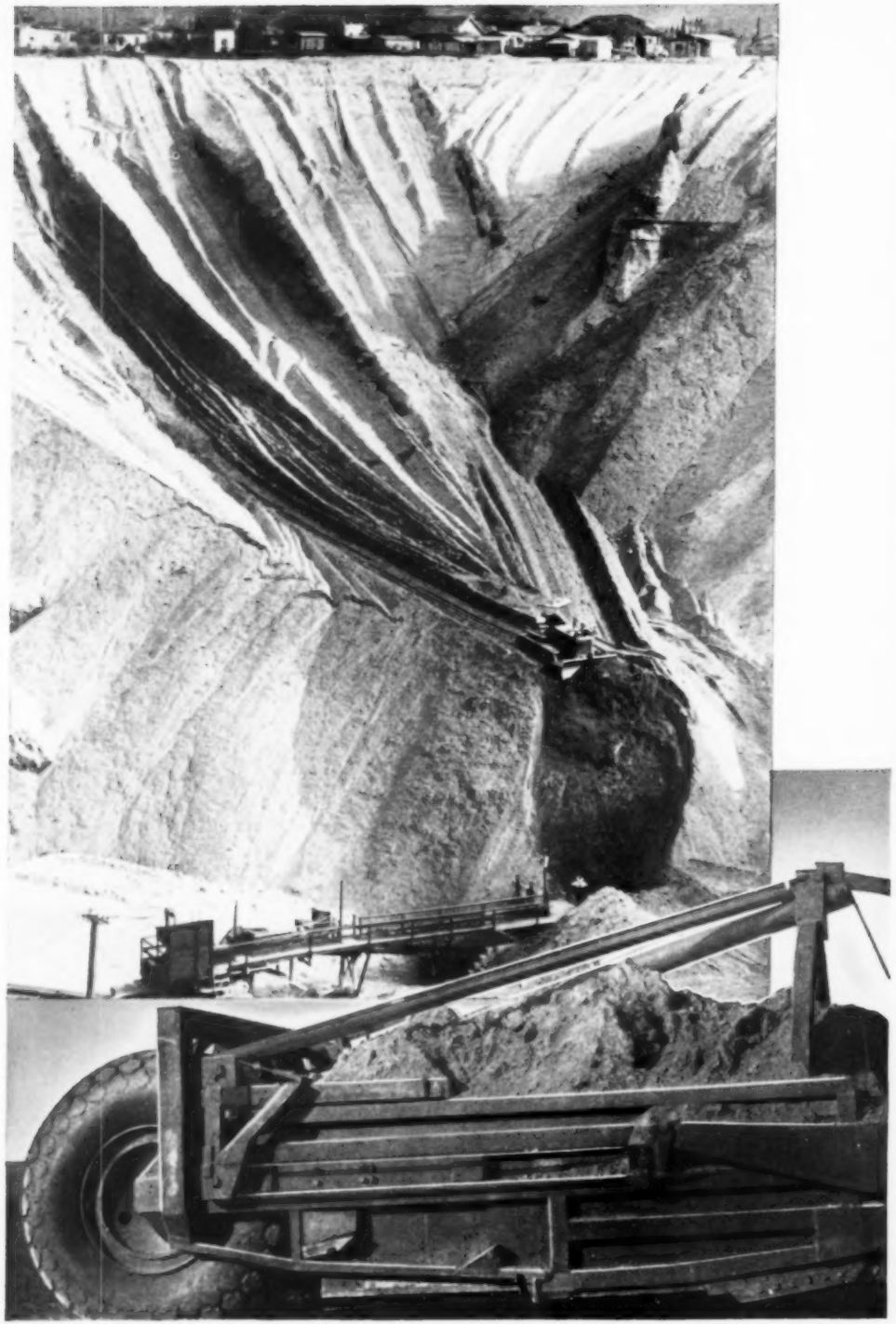
SLICED neatly into ten pieces, the 205-foot excursion steamer *Mount Washington II* recently traveled 300 miles by rail from Burlington, Vt., on Lake Champlain, to Lakeport, N. H., on Lake Winnepesaukee. It is believed the largest ship ever transported in this novel manner. Welded together after its arrival, the all-steel vessel was expected to prove even stronger than when it first was built. The unusual transfer was made to replace another boat for tourists, which was destroyed by fire last winter. Accompanying photographs show how sections of the *Mount Washington II* were carried on flat cars and reassembled.

"Pipe Finder" Gives Warning as Power Shovel Nears Line

WEARING headphones, a power-shovel operator now can excavate right up to a buried pipe or electric cable without damaging it, for a warning buzz tells him when to stop. Resembling a radio set, the "pipe finder" is connected to the excavator's frame, a battery, and any visible part of the conduit. A control dial compensates for the difference in electrical resistance of dry, wet, and rocky soils.



If his shovel comes near a pipe line, the operator hears a buzz. Illustration at left shows panel and how it operates



Moving the Earth

MECHANICAL MONSTERS HELP BUILD DAMS

UP A twisting canyon leading to the crest of California's two-mile-long Hansen Dam, a strange snakelike vehicle rolling on giant tires taller than a man eased to a stop the other day and dumped more than thirty-three tons of mixed sand and silt. The spreading of that load marked the practical completion of the largest earth-fill structure ever built, and ended the first practical test of several ingenious earth-moving machines designed to pick up loads that would tax the capacity of railroad freight cars and carry them at speeds of thirty miles an hour across rough ground.

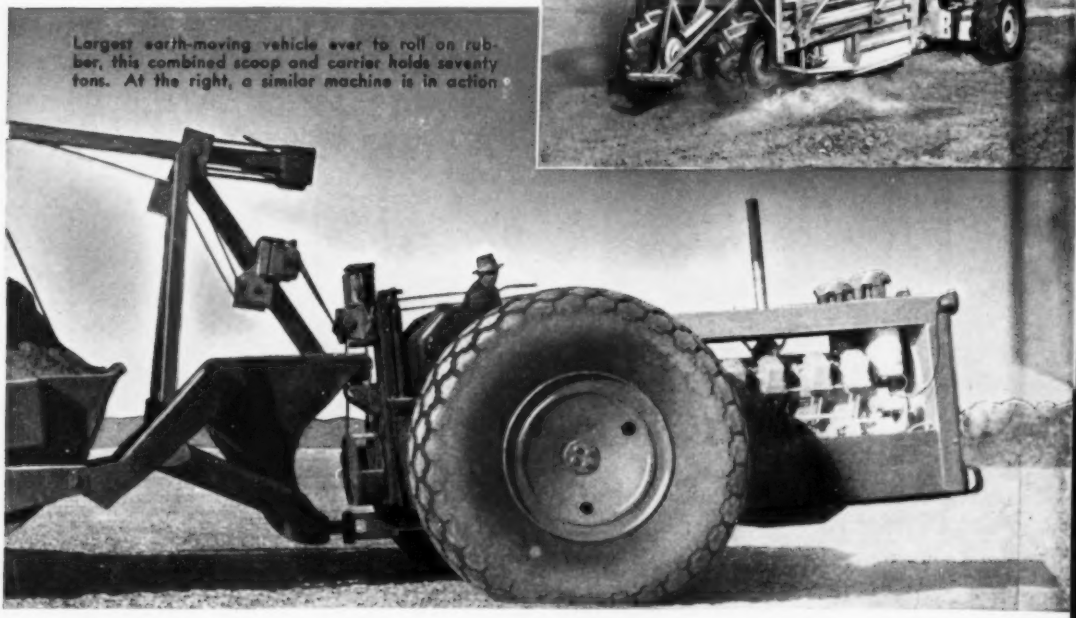
Month by month, the men who turn out these mechanical monsters for moving earth surpass their own amazing records. Until recently, self-loading scrapers rolled on four wheels and were towed by tractors. Then R. G. Le Tourneau, a wide-awake mid-western manufacturer, conceived the idea of combining tractor and trailer into a single vehicle. The result was the Tournapull, a balanced two-wheel unit mounting the engine, linked by a novel coupling to a two-wheel carrying vehicle.

Through a system of cables, the operator raises the nose, depressing the center and causing the scraper to bite into the earth. When it's loaded, the front gate is closed. Raising the center, the driver then roars away at a half-mile-a-minute speed.

The first of these odd cargo carriers mounted thirty-four-ply tires weighing 1,500 pounds, and hauled forty-five tons of loose dirt and gravel—more than a box car can handle. Recently, Le Tourneau completed a new giant, one riding nine-foot tires. These machines are capable of taking into their powerful steel jaws seventy tons of materials, or almost enough to fill two railway box cars. Soon a 150-ton model, capable

By ANDREW R. BOONE

Largest earth-moving vehicle ever to roll on rubber, this combined scoop and carrier holds seventy tons. At the right, a similar machine is in action



Hauled by cables up the face of an earth dam, a rock spreader deposits stone in an even sheet as the load pours out the rear gate over rollers

of carrying more dirt than eighty small trucks, will be available.

Neither springs nor steering wheels have been built into these odd machines. Their high-power Diesel engines project in front of the wheels like large trunks. To turn, the operator slips a cone clutch and applies a brake on one wheel. Engine power delivered to the opposite wheel swings the unit in less than its own length.

Walk around any of these big construction jobs, and you'll see these tractor-drawn trailers bouncing twenty - five miles an hour across ploughed fields, with tons of loose dirt piled high. Whereas trucks must stick to prepared roads, these babies can go almost anywhere.

Formerly, rock was spread over the slopes of dams from trucks lowered by cables. Engineers were unable to smear the heavy covering to a uniform thickness, however, so a spreader which distributes the rock evenly, and to any desired depth, was developed. Resembling a large dump - truck body, the machine is filled by trucks. Held in check by cables running to an electric crane, the skip rolls by gravity to the dumping area. There, half the load slides out on rollers as the machine moves slowly uphill. Next, the front of the body is elevated, and the remainder of the load is scattered.

The big machines must be kept going, day and night, to guarantee profits on contracts running into the millions. Formerly long drag lines would pull in scoops of earth, and lift it into waiting trucks. To

Check your oil? A traveling service station, manned by four men, keeps the trucks and tractors rolling

You could buy four medium-priced automobiles for the cost of one of these mammoth tractor tires. Fixing a flat is a job for Gargantua, as the tire weighs a ton and a quarter and the tube, being inserted at the left, weighs 143 pounds. Below, a crane is used to lift a tire

beat this operation by a few seconds, Walter Hollerbach, a western contractor, invented a combination drag line and conveyor. Now the bucket pulls earth into a bin, and an endless belt raises a continuous stream of the tiny particles, dropping them into the rolling bins. By this means, earth is stored at the foot of the conveyor, moving upward when the operator presses a switch to fill a truck.

To keep these valuable machines on the move with a minimum of costly breakdowns and repairs, a traveling service station made its appearance at Hansen Dam not long ago. Four men operate the unit. In five minutes after swinging into action alongside a tractor or truck, they can fill up the fuel-oil tank, check and fill all tires, completely lubricate the mechanism with compressed-air grease guns, replenish the gasoline supply for the starting engine, and fill the radiator. On big jobs, these trucks move from vehicle to vehicle, to keep the wheels turning without delay.

How are flats repaired? It takes three men, pulling at a six-foot wrench, to remove a 2,643-pound tire from the axle of trailer or scoop. When the casing falls off, it must be picked up by a crane. No less than two pairs of hands can pull out the 143-pound inner tube from the giant shoe.

After the heavy tube has been repaired, it again is inserted in the casing, a protecting flap weighing fifty-one pounds shoved into place, and the tire lowered in a cable sling onto the wide rim. The tire, held in place by two rings, then is inflated to a pressure of fifty pounds, and lifted against the axle.

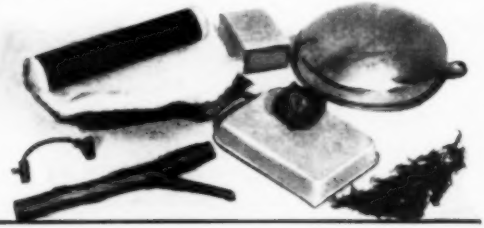
Ready to roll, these tires stand 104.8 inches high, are nearly three feet wide, and will carry 41,200 pounds each through dirt and gravel at a speed of twenty-five miles an hour. Although they cost $4,285 apiece, including a $375 tube, you can scarcely compare their mileage with the tires on your car, for they seldom roll along a paved highway. Regardless of cost, however, men must move earth on rubber; for these tires supply the only springs on their bridgelike vehicles and make possible highway speeds over broken ground.

Round the

TAKING pictures of places he has never visited provides an unusual hobby for Ernest E. Draper, of Scarsdale, N. Y. Working all day as a commercial photographer, and teaching at night in the School of Modern Photography, he has no time to spare in visiting scenic spots of the world. So he does the next best thing, and reproduces them in miniature in his cellar workshop. His camera clicks, and he has a photograph simulating a Dutch windmill, a street scene in Algiers, a Rocky Mountain landscape, or a diver opening a treasure chest on the floor of the sea. Hung in salons, his views have been praised by critics, and show such realism that many a visitor insists he has stood at the very spot portrayed!

Only the simplest of materials,

MOUNTAIN SNOW SCENE. You may think you have seen the very spot shown in the photo above, but you haven't. It is a synthetic setting built up by Ernest E. Draper, table-top cameraman, from the simple materials below



A reflector with a locust twig stuck on it for a tree trunk forms the foundation of a hill, which is covered with cotton snow as seen below

For foliage, a sprig of arbor vitae is pinned to the tree, and more of the same material is scattered about in the snow to represent bushes

World on a Table Top

available to any camera fan who would like to try his hand at the novel pastime, are used by Draper to obtain his striking effects. Because of the enormously reduced scale of the table-top scenes, various mosses serve well for grass, locust twigs for tree trunks, and delicate sprigs of cedar for foliage. Cotton, sprinkled with ground asbestos and salt, makes convincing snow. Cardboard forms buildings. Modeling clay, useful for human figures and various objects, also comes in handy for sticking trees and other features in place.

For a background, Draper projects a lantern slide upon a backdrop of tracing paper. Either a standard projector or a photographic enlarger may be used. Backgrounds may also be drawn, painted, built up, or enlarged from actual photographs. A single 100-watt bulb in a simple reflector illuminates the foreground; opposite it, a sheet of cardboard acts as a reflector to lighten the dense shadows that it casts.

Photographing the finished setting. The background is a genuine mountain photograph projected on a tracing-paper screen by an enlarging camera. Note the lighting

In order that the snow may present the proper texture to the eye of the camera, the cotton is first sprinkled over lightly with ground asbestos . . . .

. . . after which the whole scene is coated with salt from a flour sifter. Above, Draper sticks cut-out birds on glass just back of the tree

NOVELTIES

Note how the adjustable socket centers the bulb in the reflector. Right, extended for broad beam

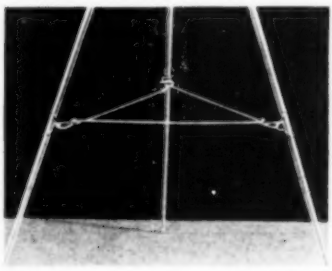
Adjustable Reflector Socket Gives Controlled Lighting

SLIDING both in and out and up and down, the socket of a new photoflash reflector permits the user to center bulbs of various sizes and to determine beforehand just the type of beam the reflector will throw. By elevating the socket, midget bulbs can be focused to give off an even light, while depressing the socket permits the reflector to accommodate larger-size bulbs. Pulling the socket forward or pushing it toward the reflector governs the width of the reflected beam. The nearer the bulb is to the reflector, the narrower the beam. Like a convertible lens, permitting both wide-angle or telephoto shots, the new reflector enables the user to adjust his lighting to different conditions and for various effects.

Cotton Holds Tints in Color Kit

COTTON BATTING, impregnated with colors for tinting photographs, is now supplied in kits for the amateur. After a bit of cotton is wound about the end of a pointed stick, it is dipped in water and the tint is applied to the photograph. According to the manufacturer, the colors can be applied to prints of any type surface. If incorrectly applied, the tints can be eradicated with a chemical solution.

Color-impregnated cotton is wound on a stick and moistened



Spring Clamps and Rods Anchor Tripod Legs

TO PREVENT tripods from slipping when set up on tile or smooth linoleum floors, a simple spring-clamp attachment has been marketed by an American manufacturer. The clamps, which can be adjusted to any position on the legs of the tripod, anchor a trio of horizontal metal rods which prevent the legs from spreading on slippery surfaces.

FOR CAMERA FANS

Chemical Outfit Tones Prints Without Need of Bleaching

PRINTS can be given a blue, brown, red, or green tone in a single operation by means of a new toning outfit which eliminates the necessity of bleaching the photographs. After the print is developed in chemicals that come with the kit, it is placed in the toning solution until the desired depth of color has been attained.

Photo Album for Enlargements Uses Loose-Leaf Binding

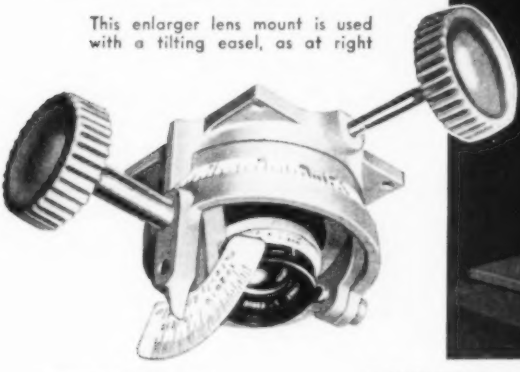
AN ALBUM without pages is a new aid to filing choice enlargements. Between covers of transparent plastic material, a ring binding holds narrow strips coated with adhesive and protected by a transparent covering. To attach an enlargement to the strip, the covering is removed.

Enlargements are cemented to loose-leaf strips

Novel Swing-and-Tilt Lens Mount Corrects Distortion

DISTORTION in snapshots taken at an angle can be corrected during enlargement by a new swing-and-tilt lens mount used in connection with a tilting easel. Objects in the picture can be lengthened or shortened by swinging and tilting the lens. According to the maker, the entire picture can be focused sharply on the tilted easel without stopping down the lens.

This enlarger lens mount is used with a tilting easel, as at right



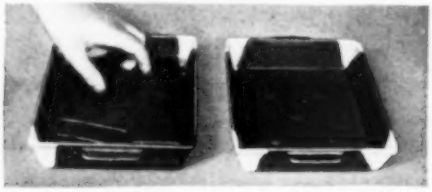
Movie "Tripod" Stands on One Leg

Folded, the support rests on a neck strap, and fully extended it is set on the ground, to steady a camera

FINISHED in black lacquer and polished aluminum, a telescoping metal leg provides a steadying support for home-movie cameras. The fifteen-ounce accessory can be supported by a neck strap or on the ground.

Darkroom Trays Identified by Bright-Yellow Corners

YELLOW corners on rubber-coated darkroom trays show the amateur at a glance which tray holds a given solution, and let him use the same trays for the same solutions each time. The trays have one, two, three, or four yellow corners.

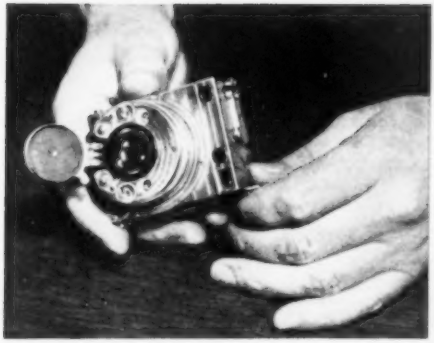


The number of yellow corners on each tray labels it

Tyro's Kit Holds Everything from Camera to Enlarger

EVERYTHING from a camera to an enlarger comes in an inexpensive beginner's kit recently marketed. The outfit contains, in addition to a fixed-focus camera and a midget enlarger, a reel-type developing tank, a darkroom thermometer and stirring rod, three plastic developing trays, clips, film, chemicals, printing paper, and a darkroom safe light. The kit enables the tyro to cover all phases of photography.

Using the enlarger and easel that come with the outfit shown with all its accessories — including a camera—in the photo at the left

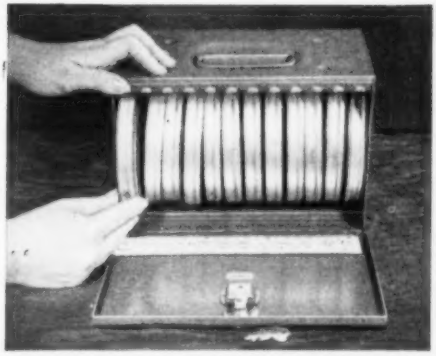


Many Built-In Accessories Feature Midget Camera

LITTLE larger than a pack of cigarettes, a precision camera built by Swiss watchmakers and recently introduced in this country provides a surprising variety of features. Four built-in filters are selected by a small knob. There is a built-in exposure meter, a built-in sunshade, a self-timer, and devices for taking stroboscopic pictures, panoramas, and pictures at right angles. The camera's midget tripod is no larger than a fountain pen and has a handy vest-pocket clip.

Lever Ejects Movie Reels from Handy Container

PRESS a lever and out pops the reel of home-movie film you desire from a new metal storage cabinet holding a dozen eight or sixteen-millimeter reels. When the cabinet is opened, the side swings down revealing a strip beneath the film cans on which is written the contents of the various reels. Pressing the lever above the desired reel ejects the can holding it.



The automatic container holds up to a dozen films

Folding Darkroom Is Easily Stored When Not in Use

WEIGHING only forty-five pounds, a light-proof, dustproof, collapsible darkroom is now available for apartment dwellers and those living in homes where a permanent darkroom is impossible. Assembled, it provides a working space 7′ long, 6½′ high and 3½′ wide. It can be knocked down in a few moments and when folded forms a compact unit only 46″ by 26½″ by 8½″. The folding darkroom is constructed of special, double-faced box board.

Ideal for apartment dwellers, this roomy folding darkroom requires little storage space

Clipped to the edge of a tray, thermometer is out of the way

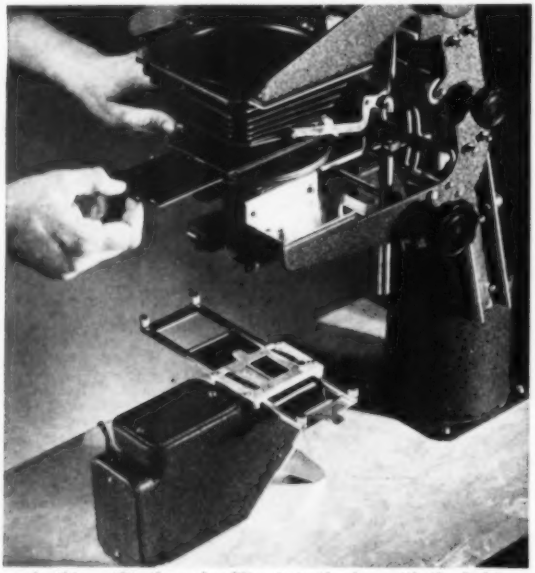
Tiny Thermometer Clipped to Tray

CLIPPING to the edge of a photographic tray, a midget, out-of-the-way thermometer gives a constant check on the temperature of chemical solutions used in the development of negatives, prints, and enlargements. The black expanding fluid in the thermometer is said to be easily seen under safelights.

Phonograph-Disk Shutter Checker

BY PLACING a specially marked paper disk on a phonograph turntable and photographing it with the turntable revolving, the amateur can test the speed of his between-the-lens shutter. The distance a dot on the circumference of the disk moves during the time the shutter is open varies according to the length of the exposure.

Photographing the revolving disk on a phonograph turntable. The developed film is projected on the disk's back to get shutter speed



In this outfit, the color filter is in the box with the light

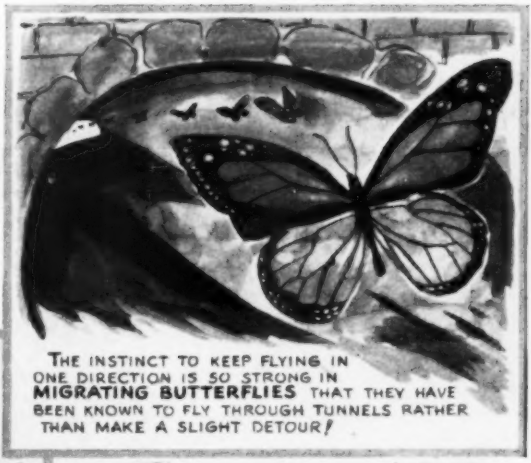
Apparatus Simplifies Color Separation

REVERSING the usual procedure for making color-separation negatives from color transparencies, a new darkroom appliance is said to produce improved results. Ordinarily, the transparency is placed in an enlarger and the image projected three times on panchromatic film, with a different-colored gelatine filter placed between the transparency and the film each time. The new method employs a special metal box containing a lamp that illuminates the transparency from behind with the gelatine filter inserted between the light and the transparency. A camera holding panchromatic film is focused on the illuminated transparency to record the separation negatives. The new procedure is said to prevent fogging of the film.

Un-Natural History

BY *Gus Mager*

OUR SOUTHERN **TOAD** SWELLS UP LIKE A BALLOON AND REARS HIGH ON ITS LEGS WHEN FRIGHTENED OR ENRAGED



THE INSTINCT TO KEEP FLYING IN ONE DIRECTION IS SO STRONG IN **MIGRATING BUTTERFLIES** THAT THEY HAVE BEEN KNOWN TO FLY THROUGH TUNNELS RATHER THAN MAKE A SLIGHT DETOUR!

IN A BOTANICAL GARDEN IN THE CANARY ISLANDS IS A HUGE **WILD FIG** TREE FROM BURMA, WITH FIGS THREE AND FOUR INCHES IN DIAMETER BUNCHED ALONG ITS TRUNK AND BRANCHES FROM THE ROOTS UP!

NIGHTHAWKS ALWAYS SIT LENGTHWISE ON A BRANCH, NEVER CROSSWISE LIKE OTHER BIRDS! THE REASON: TINY, WEAK FEET!

LIVING IN GLOOMY CAVES OF CENTRAL AND SOUTH AMERICA, THE FEROCIOUS **SMOKY JUNGLE FROG** KILLS AND DEVOURS ANY LIVING THING UP TO TWO THIRDS ITS OWN BULK!

ALTHOUGH SOME **SHARKS** LAY A FEW EGGS IN LEATHERN CASES, USUALLY THE EGG STAGE IS PASSED WITHIN THE PARENT'S BODY AND THE YOUNG ARE BORN WELL DEVELOPED!

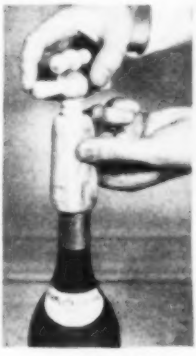
Handy Helps

ROASTER OVEN. Attractively designed, a new-model roaster oven can be placed on the table for serving buffet meals. The lid has a transparent window of heat-resisting glass

SPICE WHEEL. A dozen kinds of spices are contained in jars which are held by their caps to the rim of the wheel seen above. Fastened to the wall or a cabinet, it is turned until the desired condiment is at the bottom and the jar is removed for use

WASH THERMOMETER
A handy item for users of electric washing machines is this thermometer, which shows the correct temperatures for washing many kinds of fabrics. Directions are printed on the back

TWIN CORKSCREW
No tugging is needed to draw a cork with the double corkscrew below. Turning the upper handle drives the screw home. Then the larger handle is turned to draw cork



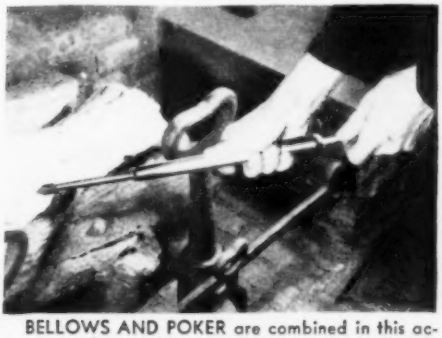
CABINET DRIER. In addition to drying small articles of clothing, this electrically heated cabinet also warms the bathroom and serves as a linen-supply closet

for Homemakers

THREE-BLADED FRUIT KNIFE
Built like a hack saw, a new knife for slicing fruit and tomatoes has three blades so that it cuts three slices at a time. Blades are spaced about an eighth of an inch apart, and are serrated for half their length

PORTHOLE CHIFFONIER. Selecting a shirt is a simple matter with the new chest of drawers illustrated above. The windows in the shirt compartment make it possible to locate the color that is wanted without mussing the whole drawer

EASILY EMPTIED CLEANER BAG. Designed to fit any bag-type vacuum cleaner, the dust bag shown at the left has a sliding door through which dirt can be emptied into a metal container having a carrying handle



BELLOWS AND POKER are combined in this accessory for wood-burning fireplaces. In the handle is a small pump which blows air through the hollow poker shaft when the grip is worked back and forth

Applying the new floor finish. It dries within twenty-four hours

Cheese Flavored by Hickory Smoke

Cheese comes out of the "smoke house." Hickory kindling is used

CHEESE, like tasty hams, now is being flavored with hickory smoke. In the process developed by experimenters at Iowa State College, two metal chambers constitute the "smoke house." In the first, hickory kindling burns to provide the smoke, which is piped to a second chamber above it. Here it comes in contact with small rectangular pieces of cheese, wrapped in parchment. The wrapping keeps the cheese clean, while letting the flavor penetrate.

"Concrete" Finish for Wooden Floors Put On with Brush

RESEMBLING concrete but applied with a roofing or whitewash brush, as illustrated at the left, a new "paint" prevents old wooden floors from splintering. Concrete floors with a tendency to dust may also be treated successfully. Because of its extreme durability, the finish is recommended for places subjected to heavy foot traffic, such as steps, and porch flooring. Two coats give a glossy enamel surface. The finish dries in twenty-four hours, and may be obtained in four tints — green, red, brown, and gray.

Phone-Book Hangers Keep Table Clear

A CONVENIENT new set of hangers for directories, attached to the side of a home telephone table, keeps the top clear for consulting a shopping list or jotting down memoranda. Holders made of synthetic plastic, in different colors, distinguish one phone book from another.

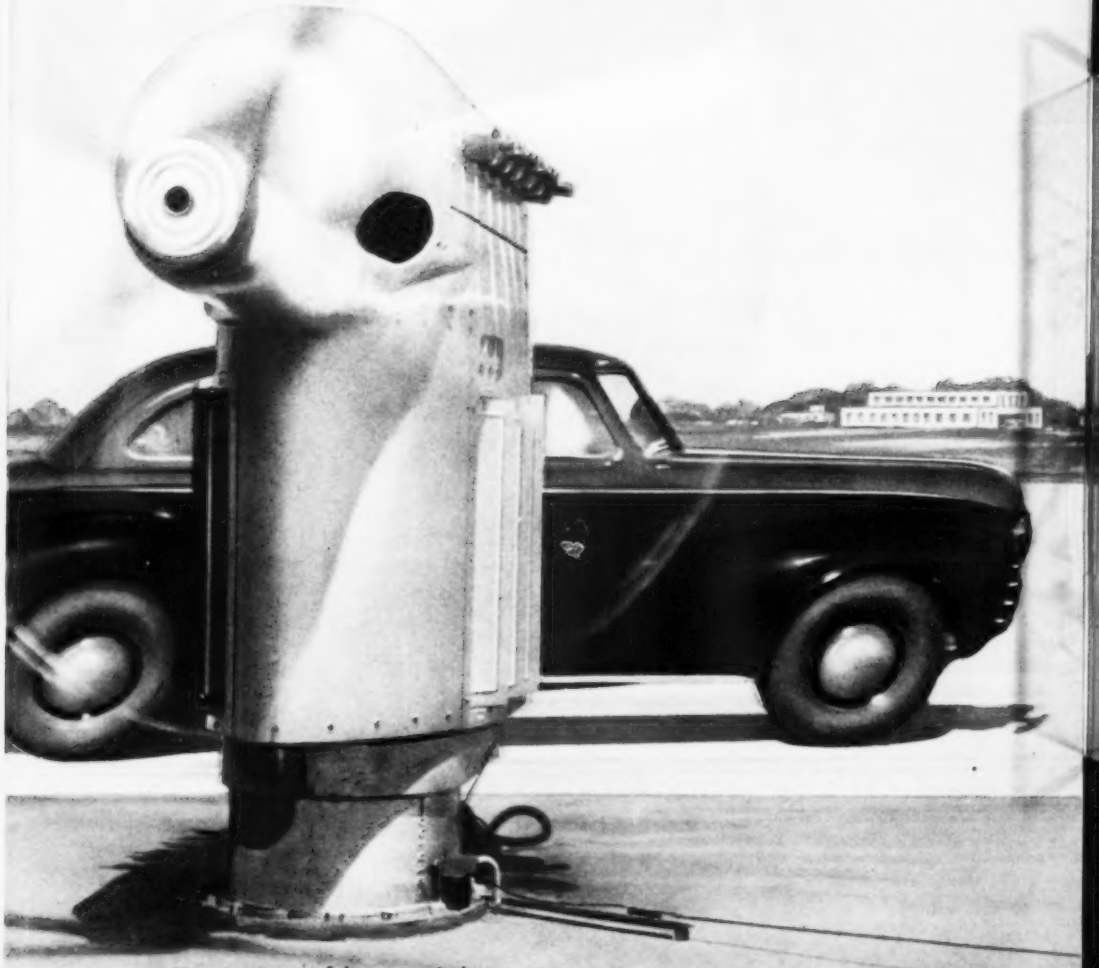
Colored hangers hold directories

AUTOS

Visit the Auto Show with Gus & Joe

HOW YOUR 1941 CAR WAS TESTED

Drivers Wilbur Shaw Won't Ride With



Have you ever felt cross winds tug at your car on a windy day? Auto engineers use this big wind machine to produce the same effect when testing new models

Testing Your 1941 Car

A new model hits the "bathtub" at General Motors' proving ground to show how it can stand a ducking

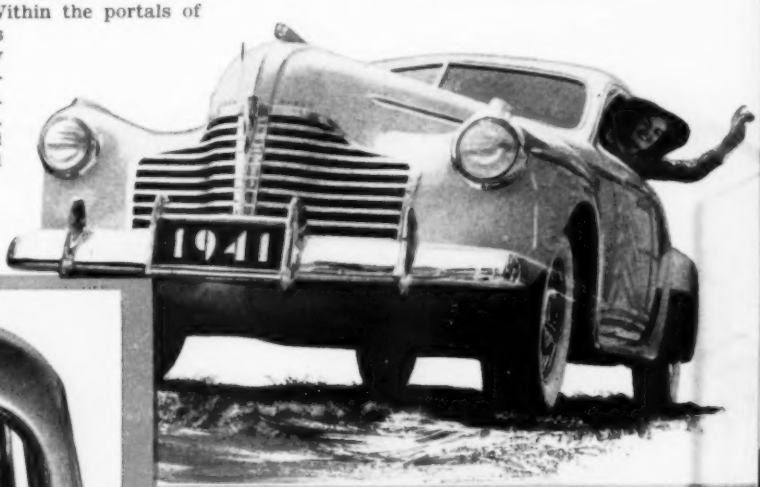
In the Laboratory and on the Proving Ground, the New Models Are Put Through Grueling Trials

How much pedal pressure does it take to apply brakes at various speeds? Trial runs with this recording device tell the story

BECAUSE engineers mounted toy-size automobiles upside down in a wind tunnel, your 1941 car will give you more mileage to the gallon than your last one. It holds the road better when a gust of wind strikes it, for test drivers have sped cars like it past the fifty-mile-an-hour blast of a giant propeller. Its greater stamina and resistance to wear are consequences of such bizarre experiments as giving gears an "artificial fever" in a radio furnace.

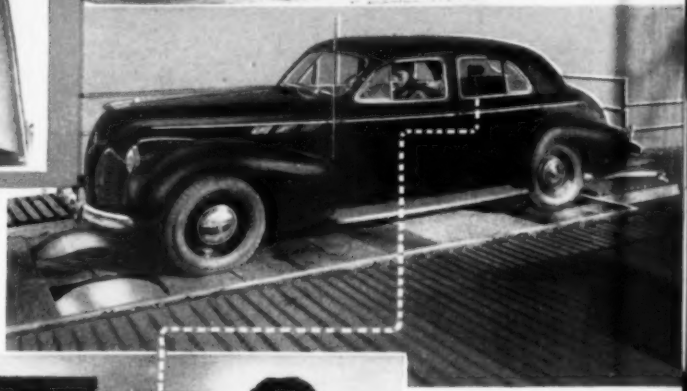
The fact that the new cars excel the 1940 models isn't any happen-so. It's the inevitable result of unceasing research and constant trial at the great engineering laboratories and proving grounds where new automobiles are born. Within the portals of these fascinating places is to be found the story behind the new cars behind the show windows.

Five thousand parts, not counting nuts and bolts, go into a typical 1941 car. To design them, and select the best materials available, research specialists employ tools that would be the pride of any leading scientific institution. A giant spectroscope reveals which of the fifty-two metallic elements are present in an alloy under test, by telltale lines visible in a rainbow of colors, while ultra-violet and infra-red photography detect other identifying lines invisible to the human eye. Transparent plastic models of auto parts, examined under polarized or "one-way" light, show just where stresses are concentrated and make it possible to eliminate useless metal elsewhere. Employing a cathode-ray tube

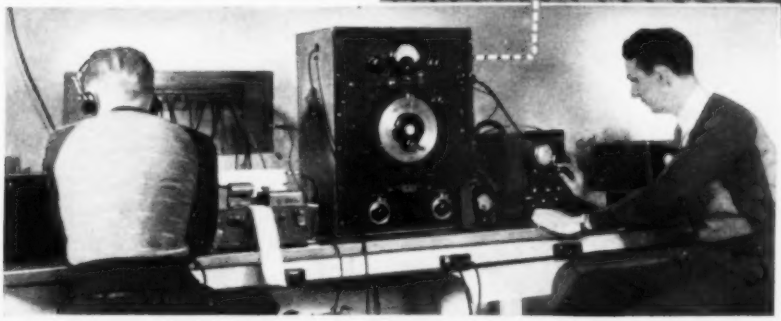


The 1941 Buick is a product of countless tests and experiments

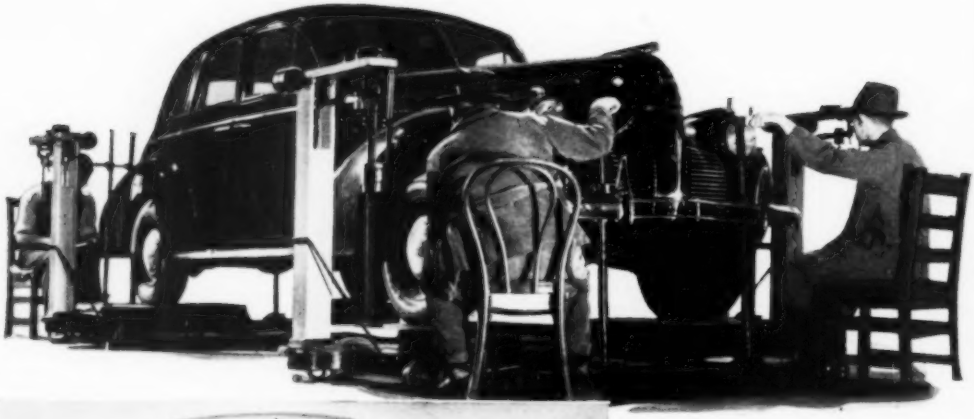
Torpedo-type design gives the new Nash a wider windshield and room for four in the front



While a car runs on rollers on a roof, as at the right, a microphone picks up body noises



In the laboratory below, engineers listen in while an instrument records any sign of a squeak or rattle



Spring-action tests on all four wheels insure riding and handling qualities of the 1941 Pontiac, at left

like those used in television receivers, an "electrical brain" combines 100 different vibrations to which a car is subjected, and sums them all up in a luminous, wavy green line, that shows just how the compensating mechanism for a "floating ride" must be designed.

Styling and engineering meet each other halfway when a new body design, modeled in miniature from an artist's specifications, arrives at the wind tunnel for test. While the operator subjects it to a

Roller-coaster hills on the General Motors proving ground try cars under real road conditions

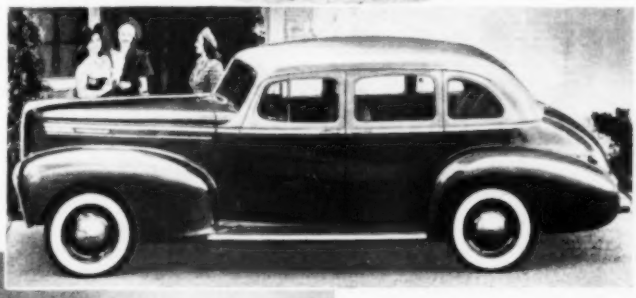
Though "new" to the public, the Studebaker below represents research and trials equal to years of actual use

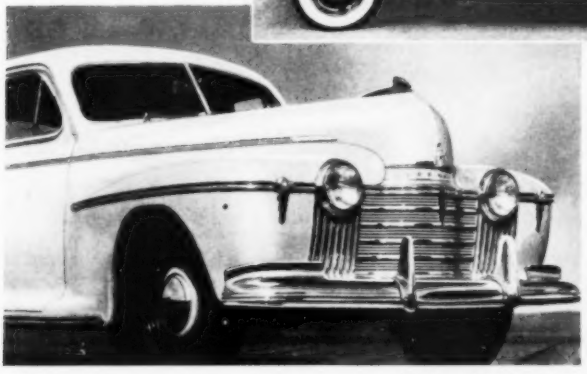
Chrysler's offering, pictured at the left, has the fluid clutch as optional equipment. The Packard below embodies sturdiness that was proved in tests like that seen in oval

breeze of measured velocity, sensitive meters and balances record its wind resistance in pounds. Only a slight change in the curve of a fender, or the slope of a rear deck, may markedly affect the engine power needed for maximum performance.

Based on myriads of such tests, experimental cars must be built and given a lifetime of wear and tear in a few weeks. Thus any possible faults are discovered and corrected before a new model goes into production. Since mistakes are expensive, both to maker and consumer, buyers get the benefit in lower cost and upkeep.

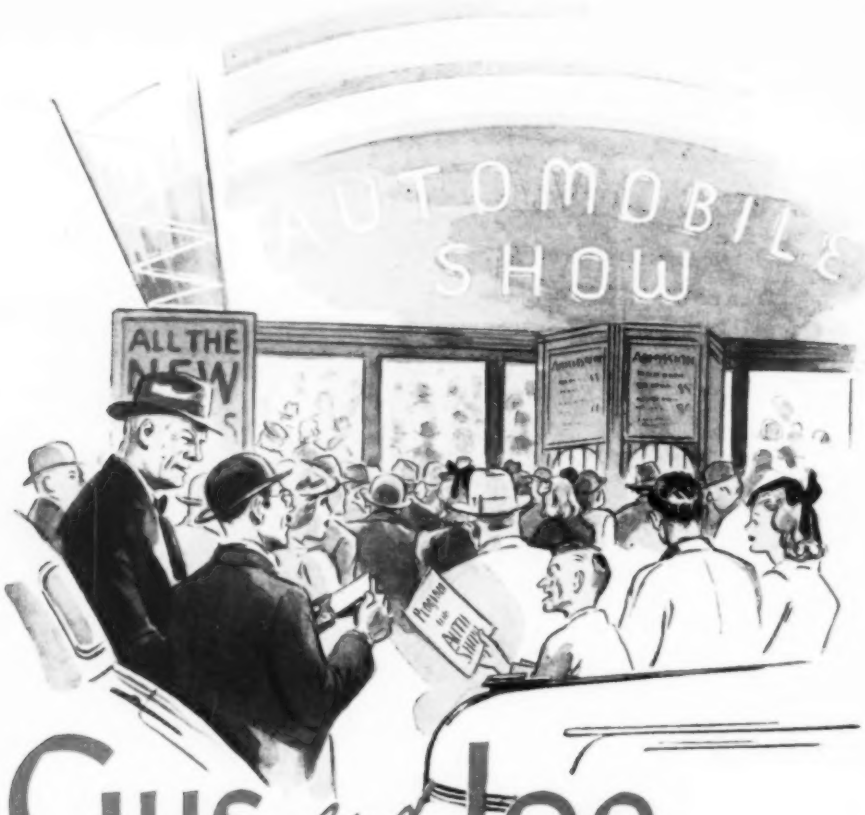
Speed lanes, hairpin turns, test hills, and "torture" roads of jagged blocks try *(Continued on page 243)*





Hudson's "symphonic styling" offers full harmony of color between the body and the interior trim — for the first time in a full line of standard cars

Running boards of the new Oldsmobile at the left are concealed when the doors are closed. Another novel feature is a silent-mesh transmission of latest type



Gus *and* Joe GO TO THE SHOW

"BY GUM, you're all starry-eyed!" Joe Clark said to his Model Garage partner Gus Wilson as they started up the broad stairway of Grand Central Palace.

"Sure I am!" Gus admitted without shame. "This New York Automobile Show always gives me a thrill, and I've been coming to it for a flock of years. I remember my first show as plainly as if it had been yesterday—and it must have been thirty-five years ago. They held it in Madison Square Garden in those days—the old Garden. Cadillacs and Oldsmobiles and White Steamers and Autocars—those old-timers look funny when they dig them out now, but they were hot stuff then. But it was an exhibit up in the balcony that interested me most—a racing car called the '999'. There was a thin-faced, quiet-spoken sort of fellow standing by it in the booth, and somehow we got to talking. He told me that his name was Henry Ford and that he had built the car and driven it at better than sixty miles an hour on the ice out near Detroit. That *was* a thrill—talking to a fellow who had driven a mile a minute! But I got a bigger thrill when I got back on the main floor and a girl came along, all dressed up to kill, and happened to give me a look out of the darndest green eyes I'd ever seen—and that goes for now, too. It sort of took my breath away, and no wonder—I heard a fellow behind me say: 'That was Anna

Let's String Along with the Model Garage Partners As They Help the Millers Shop for a New 1941 Car

By MARTIN BUNN

Held who just passed us.' Now, Joe, don't tell me you don't know who Anna Held was!"

"Yes, I know who Anna Held was," Joe assured him. "She was long before my time, but I saw a movie all about her a few years ago. It was one of those historical movies," he added unkindly. "I suppose it was the remembrance of that one look she gave you with her green eyes back around 1905 that kept you from ever getting married!"

"Well, I wouldn't go quite that far," Gus told him. "But I was young then—"

"Sure—you were young then," Joe parroted. "And now whenever you get close to a few new-style gas-buggies you go downright childish. I'll bet a quarter you'll come out of here talking about buying yourself a new car. Well, *I* won't—mine's good for another two or three years. . . ."

Gus grinned wisely as he handed over their tickets, and they started into the big exhibition hall. "Let's start by having a look—" he began, and was interrupted by a feminine voice.

"Yoo-hoo! Yoo-hoo! Oh, Mr. Wilson!"

He looked in the direction of the hail and saw the talkative Mrs. Miller and her husband, Henry.

"Oh, my gosh!" Gus muttered. "Why did it have to be *her?*"

"We'll have to talk to them," Joe urged. "We've got to be polite—they're darned good customers."

Mrs. Miller didn't wait for them to make a move. She skipped over to them, talking as she came.

"Oh, this is just wonderful!" she babbled. "You're the people I most wanted to see here! I've been coaxing Henry to buy us a new car, and at last he has recapitulated—capitulated, I mean. Now you and Mr. Clark can help us pick out the one we should get."

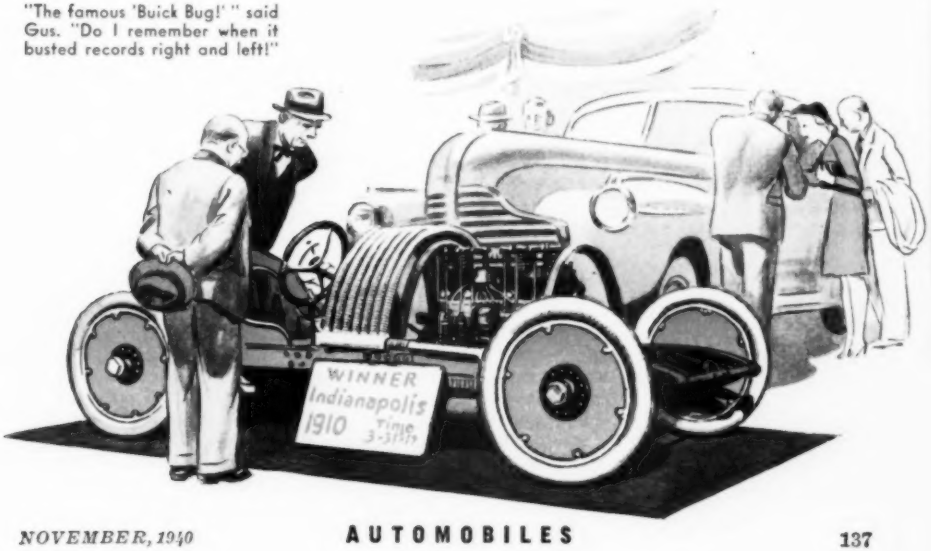
"I said 'maybe,'" her husband hedged glumly.

"'Maybe' always means 'yes,'" Mrs. Miller said archly. "I'm sure it would save us money in the long run."

"What sort of car are you people thinking of getting?" Gus put in to forestall an argument.

"I just saw one I'd *love* to have," Mrs. Miller said. "Henry hasn't seen it yet. Come on—let's all go and look at it."

She led the way down an aisle lined with sleek 1941 cars, and Gus's quick and experienced eye noted that nearly all of them looked longer, wider, and lower than the 1940 models, that many of them were more definitely streamline, that two-tone finishes were frequent, and that bumpers were more massive than any he'd seen before. But just as he was about to become vocal about some of his observations, Mrs. Miller



"The famous 'Buick Bug!'" said Gus. "Do I remember when it busted records right and left!"

"That," Gus told Henry Miller, "is the principle of the fluid clutch"

brought up in front of a Super Eight Custom "180" Packard and announced brightly: "This is the one."

Gus looked at the big beauty. Then he looked at Henry and grinned. "That's quite a lot of automobile, Mrs. Miller," he said. "It looks longer than last year's model," he added to the salesman.

"The wheelbases of all our models are the same as they were last year," the salesman told him, "but the over-all lengths have been increased by five or six inches, and the hoods are two and a half inches longer."

"What I especially like about this particular car," Mrs. Miller announced importantly, "are the really wonderful improvements you can have on it. This gentleman told me about some of them—mechanical refrigeration and air conditioning, for example. Just think, on the warmest day—"

"That's a wonderful stunt," Gus agreed, "but it's fairly expensive, isn't it?"

The salesman pressed a button on one of the doors and the open window above it closed smoothly. He pressed another button and a glass partition slid noiselessly into place between the driver's and passengers' compartments. "Power operated," he announced proudly.

"THAT'S a new one on me," Gus admitted. "Where's the gadget that runs it—under the front seat?" He examined the unit interestedly and nodded. "I see—a reversible electric motor hooked up to a hydraulic pump with a reservoir tank, and a hydraulic cylinder for each window. Mighty clever!"

The salesman realized that he was talking to a man who knew his automobiles. "We have a number of improvements this year which I seldom mention to the ladies—so few of them are interested in such things," he said. "New connecting-rod bearings. And a new pressure cooling system. It operates at four and a half pounds above the atmospheric pressure on the low-price '110' and the '120' models, and at seven and a half pounds above on the Super models, and raises the boiling point of the cooling liquid so as to permit warmer engine temperatures at all altitudes."

"That's interesting," Gus said. "I'd like—"

But the conversation had become too technical for Mrs. Miller. "I think we'd better look all around before we decide on anything," she told the salesman. "Thank you *so* much."

"Some one," Mr. Miller said, "was telling me about a car—I don't remember which make he said it was—that hasn't got any gears to shift. That doesn't seem possible to me, but if there were such a car it might be a good one for my wife to drive. She's always getting stalled shifting gears, and you know how she chips transmission teeth!"

"YOU'RE thinking about cars which have what they call the liquid clutch," Gus said. "There are several of them. There's the Oldsmobile exhibit over there. Let's have a look at their Hydra-Matic Drive—it's mighty interesting. But, say—we've lost your wife and Joe."

"Oh, they'll be all right—we'll run into them somewhere," Henry said with more than a touch of relief in his tone. "I want to take a look at this new stunt you're talking about."

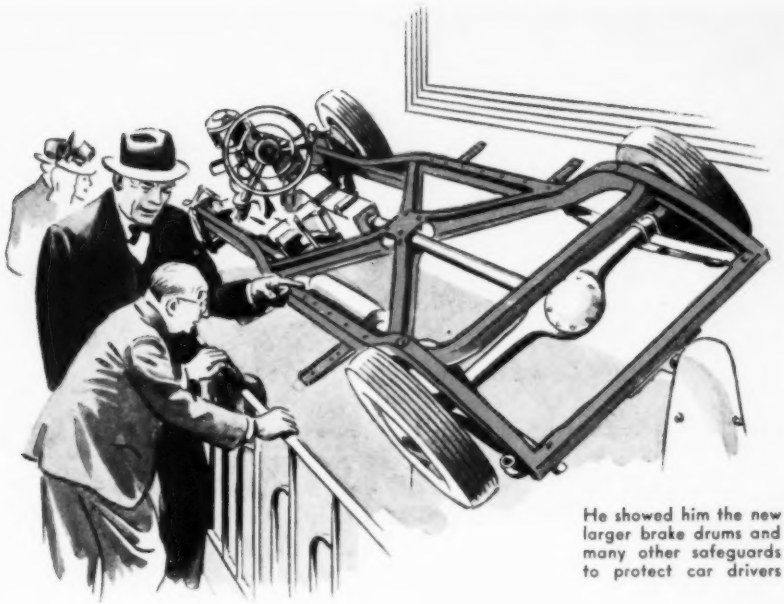
"It isn't altogether new," Gus explained. "The Oldsmobile people are continuing it from last year, as optional extra-cost equipment. Know how it works?"

"Nope," Henry admitted. "I guess I'm still just a Sunday driver who doesn't know a thing about cars."

"Well," Gus said, "you sell electric fans in your hardware store, so you know something about them. Now, suppose you hooked one fan up to a wall plug, placed another fan, not hooked up, facing it and about an inch away, and then switched on the fan you had hooked up. What would the other fan do—the free one?"

"It would turn, too."

"Right!" Gus said. "In other words, the power would be transmitted from the driven fan to the free fan through the air. Well, that's the principle of the fluid clutch. But it's worked out in the form of a liquid coupling in which oil takes the place of air. Two rotors are placed in a case filled with oil. One of them is driven by the engine. It transmits the power through the oil to the other rotor, which drives the car's



He showed him the new larger brake drums and many other safeguards to protect car drivers

wheels. In the Hydra-Matic drive the liquid coupling is used in connection with an automatic-transmission assembly. There's no clutch pedal, and no gearshift. Instead there's an automatic control just below the steering wheel. It has four positions—neutral for parking, high for normal driving, low for steep hills and heavy going, and reverse for backing. After you flip the lever into high you don't have to move it for normal driving—you step on the gas pedal when you want to go, and step on the brake pedal when you want to stop.

"Well, here are the Oldsmobiles—three sixes and three eights, varying in size and price, but all mighty pert and modern looking. Built-in running boards which are exposed only when the doors are opened. Sealed-beam headlamps—they make night driving safer. One-piece hood—when you lift it you can get at any place in the engine compartment without being a contortionist. And Hydra-Matic Drive, if you want to pay extra for it. Lots of interesting features."

Henry Miller shook his head in admiration. "You're a wonder, Gus," he said. "You just take one look at these new cars, and you know all about them."

"I'll let you in on something," Gus confided. "This is my *second* trip to the show today. I came down to town early, and when I met Joe for dinner I told him I'd gone to a movie to kill time after I'd finished my errands. Don't let on to him, or he'll never stop kidding me about it—he thinks I'm a nut on cars, and I guess he's right! That reminds me, there's one I missed this afternoon that I want especially to see—that new Nash '600' they brought out to compete with Chevrolet, Ford, Plymouth, and Studebaker in the low-price field. I met an old friend of mine who's a big shot with the Nash people now, and he told me that they'd spent three years developing and road-testing it, and seven million dollars getting it into production. Let's go and have a look at it.

"HERE'S their exhibit," Gus said a minute or so later. "And there's the new '600'—it's a classy-looking bus, isn't it, with its torpedo-type body and two-tone finish. It's a good-size car, too—194 inches over all, George told me, with full three-passenger seats. He said that it's built like a bridge—that the body and frame are a single welded unit, light, but twist and rattleproof. Another new feature is the spring suspension—coil springs on all four wheels, in tubes and integral with the shock absorbers—it's a European idea. The car has a six-cylinder engine with the manifolds sealed into the block, and they claim that an average good driver can get between

twenty-five and thirty miles out of a gallon of gas. Those other Nash cars are the Aeropowered Ambassador Six and the Aeropowered Ambassador Eight. They're in the low-medium and upper-medium price groups, and they both have twin-ignition, valve-in-head engines—they claim it's the nearest thing to an airplane power plant that you can get in an automobile."

"You say this Nash '600' was brought out to compete with some other cars. Well, let's go and look at those other cars," Henry suggested.

Gus grinned at him. "You're getting the show bug!" he said. "All right—I'm with you as long as my dogs hold out. Here's the Studebaker exhibit. Their Champion is in the low-price group. They've upped the horsepower of its six-cylinder L-head engine to eighty by making some changes in the cylinder head and the spark plugs. The car's longer and wider than last year's model, but by cutting down dead weight they've kept it under 2,500 pounds. Notice that there aren't any running boards? Those larger cars are the Commodore and President lines. You can get the new slipstream Land Cruiser model in either. Well, we'd better be getting along, Henry. There's a lot more to see in this show."

They got along. Gus halted shortly to talk with one of the Plymouth salesmen.

"How'd Plymouth step its motor up to eighty-seven horsepower?" he queried.

"New camshaft lifters," was the prompt reply. "They raise the intake valves quicker and farther, letting more gas and air enter the cylinders with a rush. There's a new intake manifold, too, that distributes the vapor better to all cylinders. They've added new bearings with five times the life of the old ones. And that's not all. That added power is multiplied still further with new rear-axle ratios that give better getaway and pick-up. And a higher gear ratio in second speed lets you use it for most of your starting, without bothering with low, unless you get in a snowdrift or mud. If customers want it, they can have a Powermatic gearshift that uses vacuum to do most of the work. In addition, there's a new oil cleaner and air filter. . ."

"Hey Gus," Henry managed to get in. "Our time's getting short."

Thanking the salesman, they moved on to Chevrolet and Ford, admiring each in turn. Both featured a host of new mechanical, accessory, and design improvements besides carrying over from last year such advanced ideas as steering-column gearshift and sealed-beam headlights, with Chevrolet again featuring the vacuum-power shift and larger Tiptoe-Matic clutch. Ford, Mercury, Lincoln-Zephyr, and Lincoln—all newcomers to the Auto Show this year—were gone over from bumper to bumper by Gus's appraising and approving eye.

Moving on, they examined the smart torpedo-bodied Pontiacs. Henry was enthusiastic over their big, comfortable bodies, and Gus over their precipitation-type oil cleaners and new-design safety steering wheels.

They looked at the Grahams—especially at the new Hollywood Custom model, a long, racy-looking car with a body wider than it is high, and its floor only twelve inches from the pavement.

Then they looked at the Chryslers—longer, wider and lower than the 1940 models. "They all have fluid drive—it's standard equipment on all eights and on one Windsor model. It's optional on the other Windsors and the Royal," Gus said. "It's the same fundamental idea as the Hydra-Matic Drive, but it's worked out differently. Chryslers have conventional transmission assemblies and clutch pedals, but under average driving conditions you can shift into high at the start of a long trip and stay there the rest of the way. On these '41 cars they've combined fluid drive with automatic safety control which suits the gear ratio to every normal driving condition, keeps the car under positive control, and automatically protects the driver on hills, in traffic, and on snowy or slippery roads."

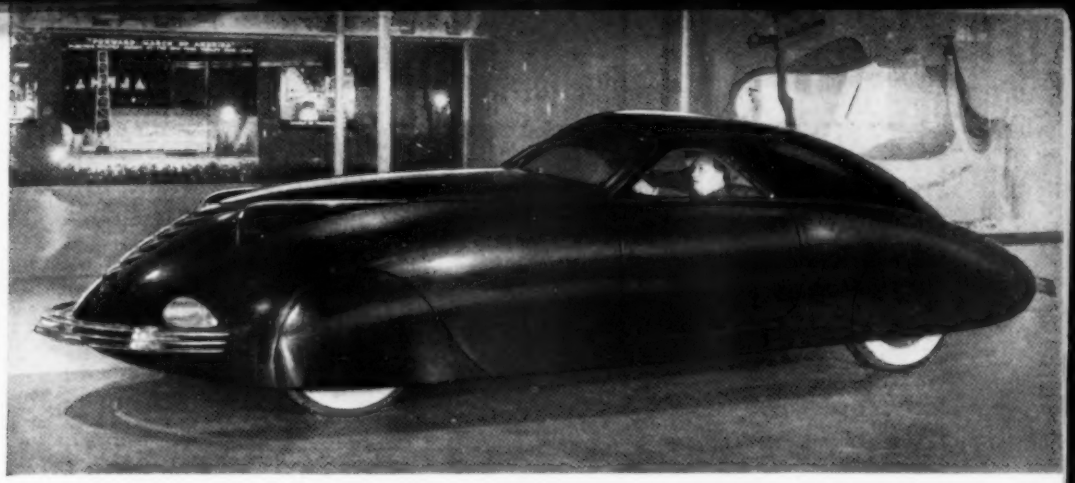
"That fluid-drive idea sounds like a mighty good thing to me," Henry said. "Did you say that some other cars have it?"

"Yes," Gus told him as they approached the DeSotos. "To name a couple more, DeSoto and Dodge. And on DeSoto it comes with a new transmission. But DeSoto is also available if you wish with a regular transmission to which a vacuum-type gearshift booster can be added.

"Those new safety rims on most of the Chrysler line keep you from throwing a tire when you *(Continued on page 241)*

GUS SAYS:

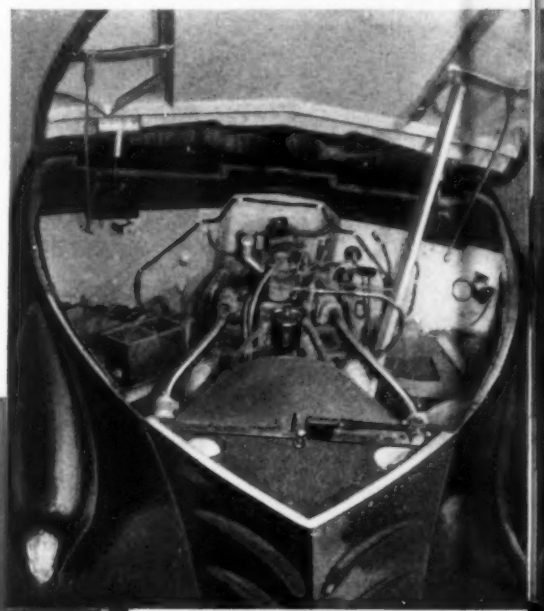
Each year I wonder how the new cars can be any better than last year, and each year at this time I find out! They just keep on coming up with more safety, power, economy, comfort, and looks! Gosh! I'm beginning to talk like the car ads, myself!



With an airplane-type motor and front-wheel drive, this fully streamline car makes 115 miles an hour

Is This the Motor Car of Tomorrow?

REPLETE with striking innovations, a motor car of tomorrow that is ready to roll on the highways of today, is part of the Electric Utilities exhibit at the New York World's Fair. Within an air-conditioned, noiseless body, the driver sits behind an instrument panel holding more than a score of dials and switches. Above the panel is a green-tinted, nonglare windshield, and below a special crash board padded with cork and sponge rubber. Doors are without handles and swing open at the touch of a button. Easily removed panels of duralumin seal the underside of the car against dust and mud, and eleven types of rubber, placed at vibration points, prevent rattles. An all-wave radio, with two speakers and an airplane-type, concealed antenna, can be tuned in from the instrument panel. The driver operates the car through an electric gearshift. Four persons can sit abreast on the wide front seat, which is formed of molded rubber to eliminate vibration and road shock. Powered by an airplane-type engine, this car of the future can reach a peak speed of 115 miles an hour.



Note the crash board beneath the dash, the padding of the top, and the hinged section of the roof to make it easier to get in and out. Above, view of power plant

These views show the glareproof rear-view mirror before and after adjustment to "dim" the headlights of a car following just behind

Mirror Kills Glare of the Car Behind for Night Driving

INSTANTLY convertible for day or night driving, a new rear-view mirror cleverly turns a familiar optical defect into an advantage. Look slantwise into an ordinary mirror, and you see double. The silvered backing reflects ninety percent of the light, giving a strong image; and the outer surface of the glass reflects ten percent, giving a weak or "ghost" image. By using glass of wedge-shaped instead of flat cross section, the new car mirror separates these two images. In the daytime, it is turned so that the strong reflection from the silver backing shows the road behind. At night, tilting it slightly upward eliminates the bothersome glare of following headlights, which, however, remain plainly visible by their dimmed "ghost" reflection from the glass surface. Dotted lines in the accompanying photographs represent the reflection from the silvered part of the mirror.

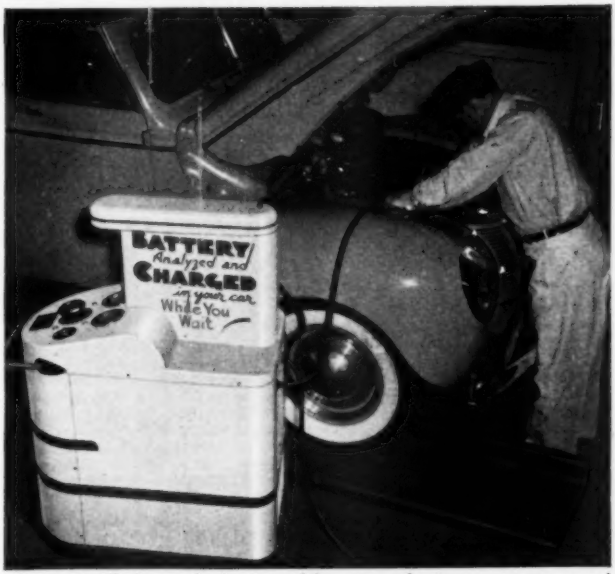
Flash Light for Mechanics Can Shine Around Corners

"Piped-light" flash in use. At the right, it is fitted with a magnet to pick up parts

"PIPING" light around corners through plastic rods, first applied in surgery, now finds wide industrial use in a special flash light for auto mechanics and radio men. Interchangeable rods of various shapes direct illumination to hard-to-get-at places. One type, with a powerful little magnet embedded in its tip, can lift parts weighing up to three quarters of an ounce. Standard cells power the light.

Car-Battery Charger Does the Job While You Wait

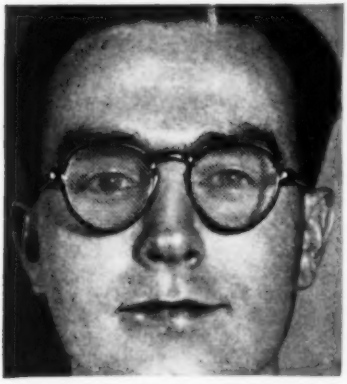
RECHARGING your car's battery while you wait, a new portable unit takes an average time of only twenty-seven minutes, according to the maker. Thus the operation may be performed simultaneously with other servicing. A special motor-generator set—the secret of the speed-up method—automatically varies the charging rate to maintain the maximum input that the battery's changing voltage and internal resistance will safely allow. Electric dials permit a preliminary sixty-second check-up on the battery, which need not be removed from the car either for testing or charging.



This unit will charge the battery while you are having your car greased

Night-Driving Glasses Use Wire-Mesh Lenses

"BLINDERS" of wire mesh in new spectacles designed for night driving are said to shield the eyes from the glaring headlights of oncoming cars. Mounted in an eyeglass frame, the screening absorbs enough light to prevent retinal fatigue, without interfering with safe vision.



Wire screening in place of glass lenses cuts down the light that reaches the eyes

Quickly Installed Air Cooler for Warm-Weather Driving

INSTALLED or removed in a few minutes, the new air cooler shown above fits any make of car. Filtering and purifying the air besides lowering its temperature by evaporating a supply of water, the device operates automatically while the car is in motion. A pair of enterprising operators discovered a way to make a tidy summer profit with a supply of the conditioners. One rented them to west-bound tourists at the Needles, Calif., gate of the Mohave Desert, while his partner collected and re-rented them to east-bound motorists at San Bernardino.

Here's My Story

WILLIAM KNUDSEN, BORN IN COPENHAGEN, DENMARK, IN 1879, WAS CHRISTENED SIGNIUS WILHELM POUL KNUDSEN. AS A BOY HE WORKED IN A BICYCLE SHOP AND HELPED BUILD A TANDEM, THE FIRST SEEN IN THE DANISH CAPITAL

JUST BEFORE HIS 21ST BIRTHDAY, KNUDSEN CAME TO THE U.S. AS HE WAS WALKING DOWN THE GANGPLANK, AN OFFICIAL SHOUTED, "HURRY UP," AND KNUDSEN HAS BEEN HURRYING EVER SINCE

HIS FIRST JOB IN AMERICA WAS AT THE SEABURY SHIPYARD IN MORRIS HEIGHTS, N.J. AS A REAMER ON TORPEDO BOATS, HE EARNED $1.75 A DAY

WHEN WINTER CAME THE SHIPYARD CLOSED DOWN, BUT KNUDSEN FOUND ANOTHER JOB IN THE SALAMANCA, N.Y., ROUNDHOUSE OF THE ERIE RAILROAD. HE WORKED SEVEN NIGHTS A WEEK REPAIRING BOILERS FOR $100 A MONTH

NEXT, KNUDSEN GOT A MECHANIC'S JOB IN THE KEIM BICYCLE-PARTS FACTORY AT $10.50 A WEEK AND "A CHANCE TO WORK UP," AND HE DID WORK UP, BECOMING ASSISTANT SUPERINTENDENT IN 1906. HE BOUGHT AN AUTOMOBILE TO CELEBRATE

THE CAREER OF WILLIAM KNUDSEN

WITH AUTOMOBILES GAINING POPULARITY, THE BICYCLE FACTORY TURNED TO MAKING AUTO PARTS. IN 1911, HENRY FORD BOUGHT OUT KEIM, AND SOON KNUDSEN WAS IN CHARGE OF ALL FORD ASSEMBLY PLANTS

THE WORLD WAR PUT KNUDSEN BACK IN SHIPBUILDING. HE WAS GIVEN THE JOB OF TURNING OUT FORD'S SUBMARINE CHASERS FOR THE GOVERNMENT. WHEN THE WAR ENDED, FORD MADE HIM HIS PRODUCTION MANAGER

IN 1922 KNUDSEN BECAME VICE PRESIDENT AND GENERAL MANAGER OF THE CHEVROLET CO. THE YEAR BEFORE HE TOOK CHARGE, THE COMPANY SOLD ONLY 76,000 CARS. DURING HIS FIRST YEAR, THE SALES TOTAL REACHED 240,000

TWO YEARS LATER, KNUDSEN WAS ELECTED CHEVROLET'S PRESIDENT. IN 1933, HE WAS MADE EXECUTIVE VICE PRESIDENT OF GENERAL MOTORS AND IN 1937 BECAME PRESIDENT

LAST SPRING, THE IMMIGRANT WHO HAD ARRIVED AT ELLIS ISLAND FORTY YEARS BEFORE WAS SUMMONED BY PRESIDENT ROOSEVELT AND GIVEN HIS GREATEST JOB— THE SUPERVISION OF AMERICA'S VAST INDUSTRIAL DEFENSE PROGRAM

EIGHT CAR TIPS FOR

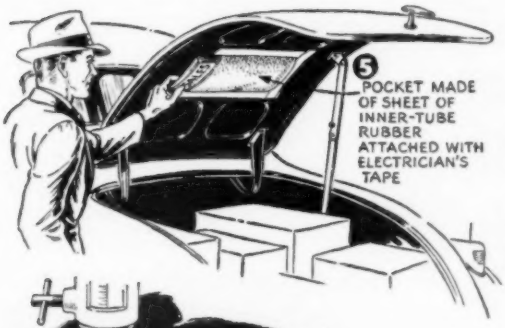
1 A HOMEMADE STETHOSCOPE for diagnosing motor ills is easily assembled from the reproducer head of an old phonograph arm and a length of $\frac{1}{8}$" steel rod 18" long. File one end of the rod, as shown in the inset at right, to fit the needle holder. Holding the reproducer up to the ear and moving the other end of the rod around on the engine block will quickly locate most engine noises.—C.O.M.

2 REPAIRS TO DENTED FENDERS are facilitated with an ordinary small bench vise used as illustrated at the right. First the vise jaws are opened wide and placed against the top of the fender so that the dent is between them, if small, and along their edges, if large. Tap the underside of the fender with a hammer to bring it back to shape. Shifting the jaws of the vise around the dent improves the job. By turning the vise in various positions, its rounded jaws can be made to conform to the fender curves.—R.J.W.

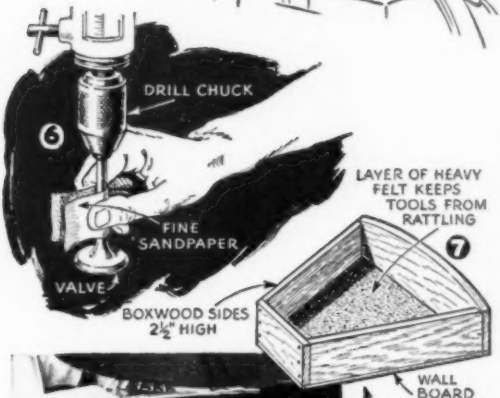
3 FOR WORKING UNDER A CAR, a piece of sponge rubber about 1" by 3" by 8" in size sewed onto the back of a mechanic's cap provides a soft cushion wherever he rests his head. Besides providing comfort, the cushion will eliminate any possibility of bruises and cuts should a slipping tool or dropped part cause the worker to jerk his head backward and downward against the floor.—N.B.

4 BUILT INTO THE HUB CAP OF a rear-mounted spare wheel, an old dome light obtained from a junk yard can be a serviceable and decorative backing light for your car. Cut a circle in the hub cap large enough to take the fixture, to which a single-wire lead and plug are attached. Then solder the fixture to the cap to hold it and provide a "ground." Connect a wire from the socket by means of a plug and long wire to a switch on the dash, and thence to one ammeter terminal. When you change a tire, switch the hub caps, too, so as to keep the light on the rear of the car.—S.A.T.

AMATEUR MECHANICS



5 SALES RECORDS AND OTHER data are stored close to a salesman's samples under the deck of his business coupe if the device shown in the accompanying sketch is used. A sheet of inner-tube rubber fastened to the underside of the compartment lid with strips of electrician's rubber adhesive tape, as indicated, will keep all papers clean, handy, and dry. Motorists other than salesmen will find such a pocket useful for storing booklets, spare maps, and other papers not needed continuously in the front seat.—G.E.H.



6 RIDDING VALVE STEMS OF carbon and oil "varnish" can be accomplished speedily by simply inserting each valve stem in turn in the chuck of a drill press, turning on the drill, and holding a strip of fine sandpaper lightly against the stem as it spins. Do not let the sandpaper touch the faces of the valves.—H.J.

7 SET UNDER THE HOOD IN THE unused space up ahead of the radiator in many cars, a tool box made as shown at the left is extremely handy. I made one for my car out of box wood, with a bottom of ordinary wall board. A felt lining in the bottom keeps the tools from rattling. Naturally, the shape and dimensions of the box are determined by the space available in your car.—A.E.O.

8 DRYING A CHAMOIS QUICKLY and often while putting the finishing touches on a car wash is a tedious operation when it must be done by hand. I found that an old clothes wringer could be used to cut the work down considerably. Whenever I wash my car, I clamp the old wringer on the end of the front bumper and set my rinsing pail in front of it. As often as necessary I souse the chamois in the water and run it through the wringer. At some spot on the rear or front bumper of nearly any car, space can be found where the wringer can be clamped. Otherwise, any convenient support located near the scene of operations can be utilized.—L.J.E.

SPEED

By EDWIN TEALE

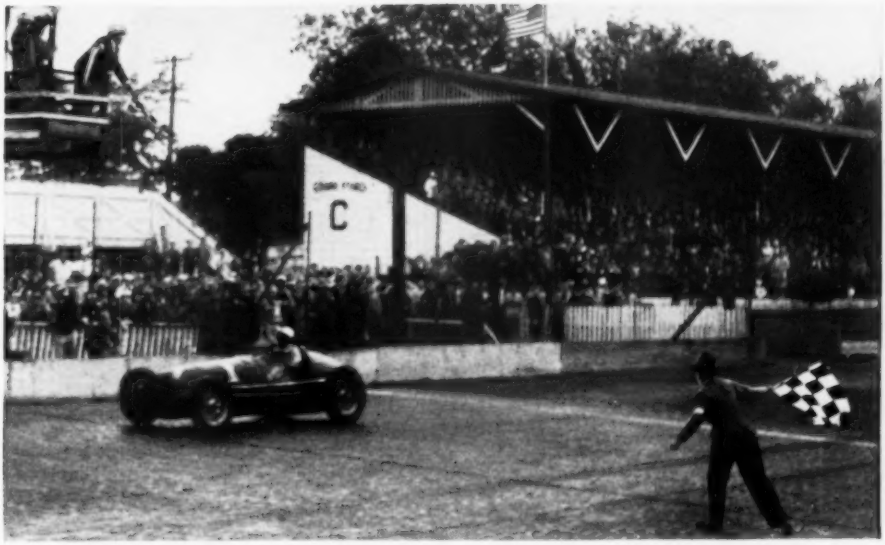
Wilbur Shaw, ace speed demon, at his racer's wheel

AMERICA'S most spectacular example of a home-town boy who has made good—at home—is Wilbur Shaw.

When his low-slung Maserati racer, slashing through rain, flicked past the checkered flag at the end of the 500-mile Indianapolis classic, last Memorial Day, it carried him to undisputed position as ace of the racing drivers. Three times, and twice in succession, he has led the field across the finish line. He is the greatest

Rolling off the track into the "bull pen" reserved for the winner. Below, the start of the 1940 Memorial Day classic. Shaw is at the center of the first rank of cars

IS HIS BUSINESS



Undisputed king of the speedway, Shaw crosses the finish line for his third Indianapolis victory

WILBUR SHAW, Three-Time Indianapolis Winner, Has Raced 40,000 Miles to Success

money winner in the annals of the historic track. The brick oval on the outskirts of the Indiana city has proved a $180,000 gold mine for Indianapolis's "car-crazy kid" who used to pedal his bicycle fourteen miles just to catch a glimpse of his heroes thundering into banked turns on practice spins.

If some one had followed Shaw around with a candid camera, recording in snapshots the most dramatic events of his life, the first picture would show a cloud of dust rising from a gravel road in the year 1910. Just in advance of the cloud was Wilbur Shaw, steering his first automobile at the age of seven. Scorching along at twelve miles an hour, he sat on the lap of a neighbor, gripping the wheel of a pioneer "Cole 8" and peering through the earliest of windshields, a circular piece of glass clamped to the steering post in front of the driver.

That early dust cloud was symbolic. Shaw has been raising the dust ever since and has been going faster and faster in the process.

First American driver to wear a crash helmet, he now also uses a polarized-light visor to kill glare on the track

By the time he was ten, he was spending so much time at the speedway that even the drivers knew him. He still remembers the thrill he got when the first of these kings of the roaring road spoke to him. "I wanted to drive a racing car so badly," he recalled when I talked to him the other day in Indianapolis, "that I could almost taste it!"

TEN DRIVERS I'M AFRAID TO RIDE WITH—

Wilbur Shaw

1 THE INDECISIVE DRIVER
He can't make up his mind . . . is too slow on the trigger . . . starts to do this and then changes to something else . . . gets flustered in an emergency.

2 THE COMPETITIVE DRIVER

He sticks out his jaw and steps on the throttle whenever a car starts to pass . . . tries to beat the train to the crossing . . . is always ready for a race with anyone, anywhere, anytime . . . thinks every highway is a speedway . . . takes dangerous chances to win.

3 THE SEE-HOW-GOOD-I-AM DRIVER
He is always showing off his skill at the wheel . . . trying to impress his passengers . . . give them the thrill of their lives . . . sees how close he can come to telephone poles and how fast he can make the turns.

4 THE SLEEPY DRIVER

He drives himself as well as his car . . . keeps on after he should stop . . . dozes at the wheel and comes to with a start . . . thinks he hasn't time for a stop by the side of the road and a short catnap . . . a pause that may save his life.

5 THE WEAVING DRIVER
He spends half his time on the wrong side of the road . . . weaves in and out of traffic . . . cuts around other cars and ducks back in line just in time to avoid a head-on collision.

6 THE TOO-OBSERVANT DRIVER

He keeps looking back at cattle in pastures . . . crops in fields . . . pretty girls on the sidewalk . . . watches everything but the road ahead . . . enjoys himself without ever realizing his danger.

7 THE JERKY DRIVER
He can't keep a steady pace . . . goes fast for a while, then slows down without respect to road conditions . . . snarls up traffic and prevents other cars from hitting an even pace.

8 THE DRINKING DRIVER
He always thinks everything is under control . . . that he is better than he is . . . speeds and takes chances without realizing it.

9 THE TALKATIVE DRIVER

He can't decide whether his conversation or his driving is most important . . . Keeps turning around to see if the passengers in the back seat are listening.

10 THE PREOCCUPIED DRIVER

He has something on his mind . . . is always concentrating on something besides his driving . . . comes to with a start just as he is heading for the ditch, a fire hydrant, or a lamp-post.

At seventeen, he quit school to drive for Bill Hunt, a local manufacturer of dirt-track racers. His machine, however, wasn't one of Hunt's hundred-mile-an-hour speedsters. It was a pick-up truck, rolling about the streets of Indianapolis on errands. Every time the youthful Shaw discovered an automobile part nobody wanted, he cleaned it up and put it in a special pile of his own in one corner of the garage. Finally he had enough parts to fit together into a racing car. About this time, one of Hunt's drivers demolished his machine in a race at Winchester, Ind. Shaw got the motor and his home-grown racer was complete.

It showed plenty of speed. But it also showed plenty of mechanical "bugs." No sooner was one defect ironed out than another appeared. To this day, Shaw refers to it affectionately as "the world's worst

bag of bugs." On July 4, 1921, at the half-mile dirt track in Lafayette, Ind., eighteen-year-old Wilbur Shaw shot away at the start of his first race. "Cotton" Henning, now his head mechanic, was one of the competing racers. At the end of two laps, Shaw, hitting a turn wide open, went straight out through the fence, crashed, rolled like a ball and got to his feet unhurt. The other Hunt drivers helped him hammer out the bent places in his car and get it rolling again after the meet was over. Then they all raced back to Indianapolis just for the fun of it!

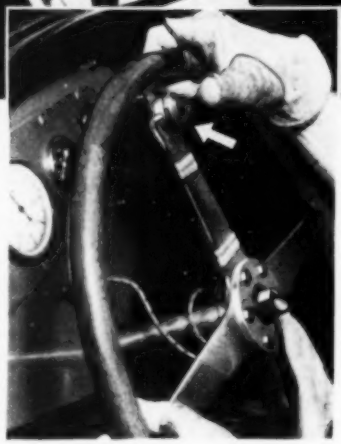
Tearing down fences at various tracks in the Middle West kept Shaw busy the rest of the summer. He had a racing heart without the skill of experience. He tried to hurl his car into every turn with the throttle against the floor boards. Usually, before the end of a dozen laps, he had disappeared from the track in a cloud of splinters. But, each time, the young "fence buster" escaped injury. In preparation for racing, he had practiced tumbling and gymnastics so he could fall and roll without breaking bones. In addition, whenever he saw a crack-up coming, he "went to the basement," sliding down as far as possible into the cockpit to get maximum protection. All told, Shaw has been in more than 200 crashes. Yet he never has been seriously hurt. Today, after nineteen years in the racing game, he is unscarred. Athletic and clean-cut, he looks as though he had been cast in the role of racing driver by a Hollywood director.

Before the start of a race, Shaw has a parting word with "Cotton" Henning, his head mechanic. Henning was a rival in Shaw's first race

Here he is inspecting the Maserati motor. As part of his preparation for a contest, he helps tune the car to as near perfection as possible

By the end of that first summer, the boy driver was demonstrating that he was a "natural." The season ended in a blaze of glory. At the old Hawthorne Track, in Chicago, his "bag of bugs" led the field to carry off the coveted Bernbach Trophy. There followed years of dust eating at leading tracks throughout the country. During one race, at Detroit, dusk closed in before the contest ended and when one car went out through the fence Shaw saw two others fol-

Shaw wipes dust off his visor with a piece of chamois tied to the steering wheel by an elastic cord. In the photo below, Shaw shows how he holds the wheel during the grueling five-hour grind of the 500-mile race classic



The photo at the left shows the crash button on the wheel for cutting the ignition if a crash is threatened

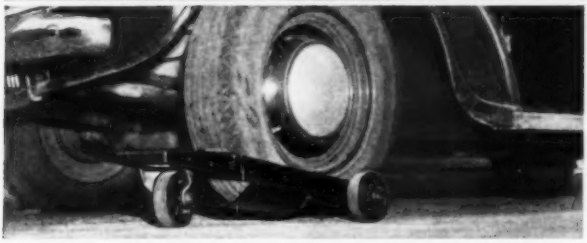
low it like sheep. Another time, at Peru, Ind., the 100-mile speed battle was fought during a snowstorm with the white flakes striking the faces of the drivers like birdshot. By 1929, Shaw was at the top of the game. In eleven championship races, he carried off nine firsts. The American Automobile Association named him the year's National Dirt-Track Champion of the United States.

Two years before that, in 1927, he had achieved his boyhood goal. When the varicolored cars roared down the brick straightaway at the start of the Memorial Day race, Shaw was hunched over the wheel of one of them. Screeching along the surface of the 3,200,000 bricks that form the vast, banked oval, he fought his way past veteran drivers and landed in the money, placing fourth.

Year after year, since then, Shaw has been one of the thrill drivers of the historic track. In the last four races, he has come in first three times and second once. In the last seven races, he has averaged more than 100 miles an hour without the aid of a relief driver. Counting both trial runs and races, Shaw has chalked up more than 20,000 high-speed miles at the Indianapolis oval.

In preparation for a race, he trains like a track athlete. He eats light meals. Breakfast, for example, consists of bouillon and bread and milk. This year, he tried taking gelatin for three weeks before the race as an aid to stamina, and believes it did him good. The constant vibration of the rocketing cars leaves the drivers sore from head to foot at the end of a 500-mile grind. During the four hours and twenty-four minutes it took to complete the 1937 race, Shaw had eleven pounds hammered off by the jarring of the brick bowl.

In the saga of this speedway, some of the outstanding mo- *(Continued on page 239)*



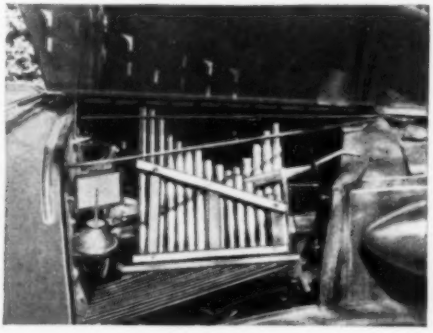
In the upper picture, Larry Kieffer demonstrates the use of his "car crutch" which holds a flat tire off the road until it can be changed

Dolly Spares Flat While You Drive to Nearest Garage

THE dilemma of motorists—whether to change a tire and soil a good suit or drive the flat to a service station and risk ruining the tire—seems to have been solved by a simple device produced by Larry Kieffer, of Philadelphia, Pa. It is a lightweight, three-wheeled dolly which can be carried in the luggage compartment of any car. In case of a flat, the dolly is placed in line with the wheel and a spiked bolt is screwed down to engage the surface of the road and prevent the dolly from moving. Then the wheel is run up into the cradle of the dolly, which holds the injured tire from contact with the ground during the drive to the nearest service station or garage. A swivel wheel makes steering possible.

Dashboard Keyboard Operates Car-Exhaust Calliope

UNDER the hood of the automobile owned by Leo Feuchter, of Ironton, Ohio, is a homemade calliope which is powered by the exhaust of the engine and played by means of an organ-type keyboard at the right side of the dashboard. Depending upon the speed at which the motor is running, the sound of the calliope can be heard from six to eight blocks away. To start the music, the operator presses a pedal, diverting the exhaust gases into the instrument. The range of the calliope is two octaves. Feuchter, a sixty-five-year-old automobile mechanic, designed and constructed the unique installation, which has attracted wide attention in parades and at conventions.



Calliope pipes installed under the hood of a car. Played with the two-octave keyboard seen at the left, the instrument uses exhaust gas

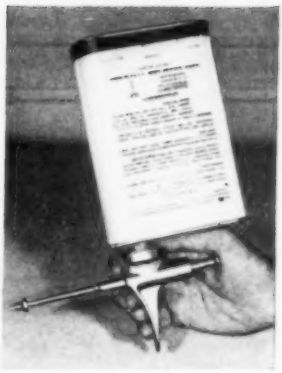
Battery Pliers and Terminal Wrench Are Servicing Aid

TWO tools in one are provided for the service man by a new pair of battery pliers shown in the illustration above. The angle of the jaws enables the pliers to grip corroded or damaged battery-terminal nuts, while at the end of each handle is a box-wrench opening, one $\frac{5}{8}$ inch and the other 9/16 inch, for use with noncorrosive-type terminals. The new drop-forged, triple-plated tool is made of chrome-vanadium steel.

New-Type Reflector Is Flameless Flare for Stalled Vehicles

MOLDED reflectors that give off a brilliant red warning light when struck by beams of the headlights of an approaching car are now available for use as "flameless flares" behind stalled trucks or automobiles. The disks of plastic material are contained in a metal housing with hinged covers.

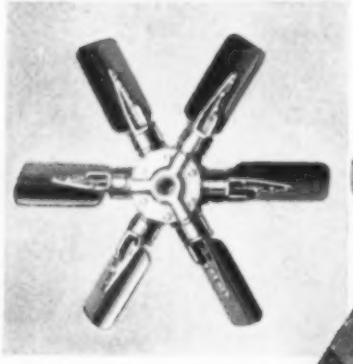
Set behind a stalled vehicle, the reflectors flash red in the beams of on-coming cars' headlights



Spray Gun To Reach Car Squeaks Fits on Oil Can's Screw Top

ELIMINATING car squeaks is simplified by the use of a new spray gun which fits any standard screw-top can of oil and throws a fine stream of the lubricant as far as the entire length of the car. The inverted feed system enables the spray gun to use the last drop of oil in the can. The fact that the can is directly over the handle of the unit makes the gun easy to operate, the manufacturer declares.

Variable-Pitch Fan Blades Control Heat of Car Motor



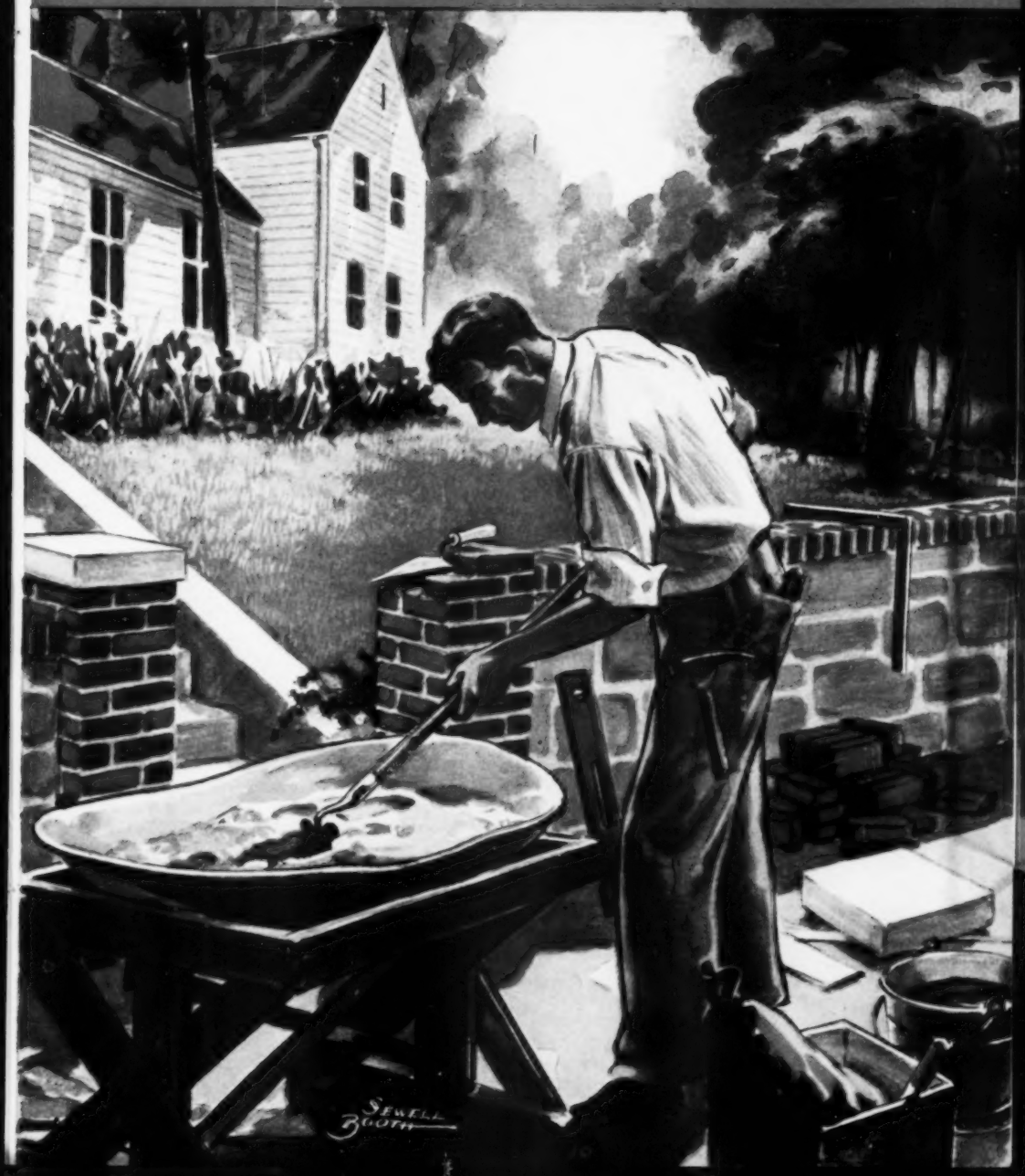
Two of the new fans, showing the variable-pitch blades controlled by a thermostat in the radiator

VARIABLE-PITCH blades on a new automobile cooling fan are adjusted automatically by thermostatic control to increase or decrease the amount of air drawn through the radiator, according to the needs of the cooling system. The thermostat, responsive to the motor temperature, varies the angle of pitch of the blades to keep just the right amount of air flowing to maintain the motor at a predetermined temperature. If no air flow is required to cool the radiator water, the blades of the fan flatten out and spin idly, saving power and fuel. The new thermostatic fan, available with either four or six blades, has been designed so it can be installed on many car motors.

HOME *and* WORKSHOP

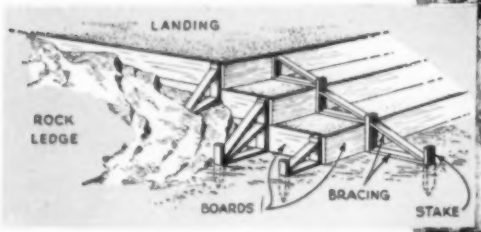
Masonry Repairs That Save You Money

• Laying Out a Shop for Small Work



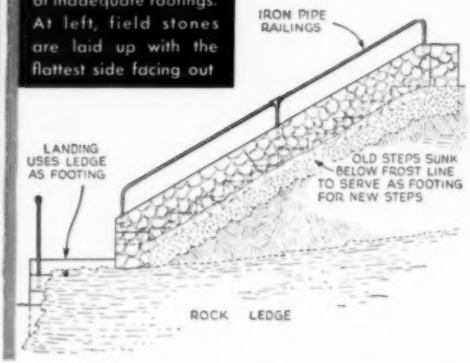
Masonry Repairs

By JOHN MODROCH



Method of placing forms for concrete steps

Rebuilding steps that had collapsed because of inadequate footings. At left, field stones are laid up with the flattest side facing out


IRON PIPE RAILINGS
LANDING USES LEDGE AS FOOTING
OLD STEPS SUNK BELOW FROST LINE TO SERVE AS FOOTING FOR NEW STEPS
ROCK LEDGE

EVERY home seems to require masonry repairs from time to time. Many of these are so simple that any handy man can undertake them successfully. It is necessary, of course, to know how to mix concrete and mortar for various purposes, and this is covered in a tabulation on a following page. It is also important to understand the general procedure for various types of repairs. Individual jobs all differ, but the accompanying illustrations show how to solve a number of common problems confronting an amateur mason.

When repairs are made necessary by lack of a solid underground foundation, the first thing to do is lay an adequate footing for the new masonry. This usually calls for digging a sheer-sided trench to the required depth, into which a mixture of concrete and large stones is poured.

In mild localities the footing need not go very deep, but where long, cold winters prevail, a depth of several feet is necessary. To be on the safe side, footings should start below the lowest possible frost line, or depth to which the ground freezes. It is custo-

That Save Money

mary on small projects to extend the footing several inches beyond the width and length of the structure. Use can sometimes be made of large buried stones and rock ledges as solid footings for masonry work.

The steps illustrated formerly ran down the slope in a long straight line. When extensive repairs on them became necessary because of their badly cracked-up condition, they were rebuilt so that adequate footing could be provided. In order to make use of a buried rock ledge that lay under the lower end, they were redesigned into the shape of a T, with the ledge serving as footing for the landing. The old cracked steps were then sunk into the slope to provide footing for the new steps built over them.

Common field stone, of which the greater part of this step project was built, can be laid up to best advantage in the manner shown in one of the photos. The flattest surface of each stone should face out. Splitting stones to give them a flat face can be done quickly with a mason's hammer or sledge and, in certain cases, with the aid of a cold chisel. Ordinary hammers and axes should not be used.

Retaining walls, such as those flanking the lower flights of steps, should be laid with a slight backward tilt, in order to increase their stability. A back-fill of loose stone can be thrown in behind the cemented facing to add further retaining strength to the wall.

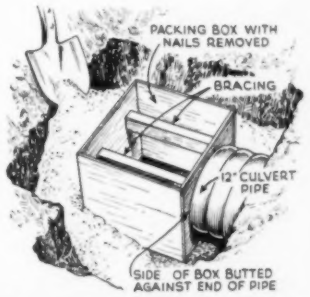
If large, flat field stones are not available, cut flagstone of the kind usually sold for walks and terraces may be used for laying a smooth tread on stone steps.

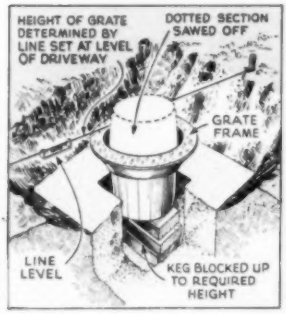
When concrete steps must be cast on the sloping side of a rock ledge, wooden forms of the type commonly used for casting steps should be prepared as shown in drawing.

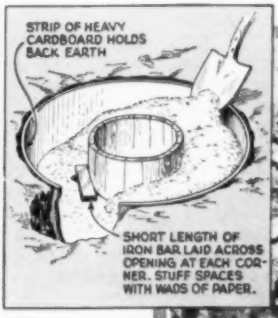
Wooden forms for casting concrete should be built of green lumber or boards well

DRAINAGE BASIN FOR DRIVEWAY

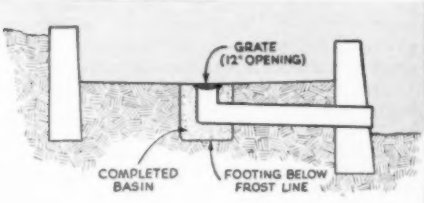
A basin of this type should be located at the lowest point, and the surface of the road pitched toward it. The lower part of the basin is cast square as at right, but the upper part is circular in shape

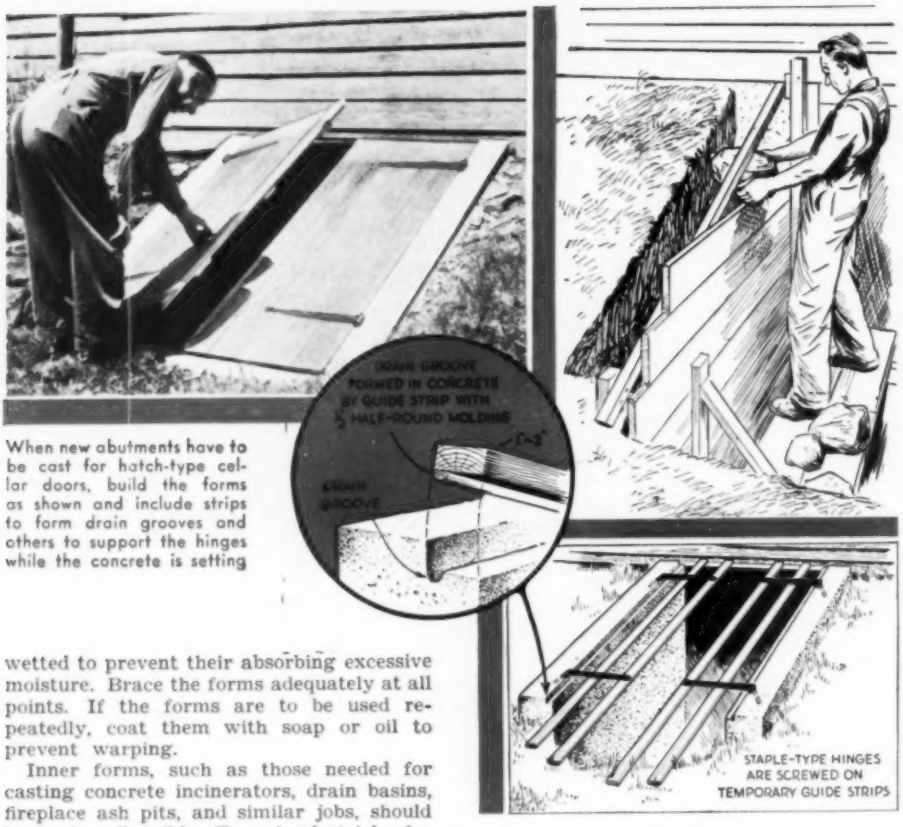



HEIGHT OF GRATE DETERMINED BY LINE SET AT LEVEL OF DRIVEWAY
DOTTED SECTION SAWED OFF
GRATE FRAME
LINE LEVEL
KEG BLOCKED UP TO REQUIRED HEIGHT


STRIP OF HEAVY CARDBOARD HOLDS BACK EARTH
SHORT LENGTH OF IRON BAR LAID ACROSS OPENING AT EACH CORNER. STUFF SPACES WITH WADS OF PAPER.

Below, cross section of hillside drive with basin




DRAIN GROOVE FORMED IN CONCRETE BY GUIDE STRIP WITH ½" HALF-ROUND MOLDING
1"=3"
DRAIN GROOVE
STAPLE-TYPE HINGES ARE SCREWED ON TEMPORARY GUIDE STRIPS

When new abutments have to be cast for hatch-type cellar doors, build the forms as shown and include strips to form drain grooves and others to support the hinges while the concrete is setting

wetted to prevent their absorbing excessive moisture. Brace the forms adequately at all points. If the forms are to be used repeatedly, coat them with soap or oil to prevent warping.

Inner forms, such as those needed for casting concrete incinerators, drain basins, fireplace ash pits, and similar jobs, should be made collapsible. Two simple tricks for doing this are illustrated.

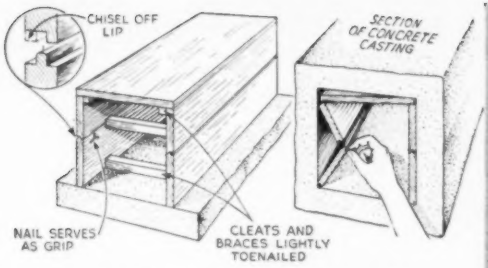
In some cases it is not necessary to make all walls collapsible. The buckling of two opposite walls will free the adjacent walls—or the third wall and ceiling, depending upon the type of form being used. All sections of the collapsed form must, however, be small enough to be pulled out of whatever opening exists.

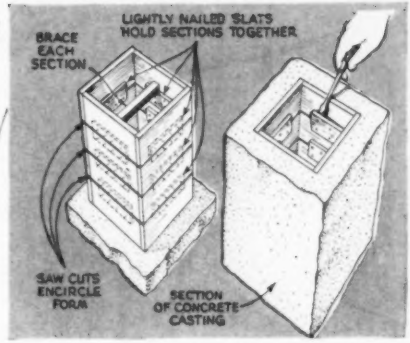
Short cuts in assembling inner forms are often possible. For example, a 12″ square packing box and part of a common nail keg were combined to make up the inner form used for casting the hillside driveway drain basin illustrated. The bottom section, it will be noted, was cast square in order to make a suitable joint with the 12″ drain pipe, while the top section was cast round to make a good bed for the frame of the round grate.

The strength of concrete mixtures varies with the cleanliness of sand, gravel, and stone and other aggregates mixed with the cement and water. The presence of top soil and other impurities prevents the cement from completely coating every particle of sand and aggregate. In other words, very clean sand and aggregate require less cement to form a concrete suited for a given job than sand and aggregate containing impurities.

Fine-textured concrete should be made by first mixing dry cement with dry sand and then adding the required amount of water. When making coarse concrete, however, it is easier to mix in the heavier aggregate, such as coarse gravel, crushed rock or cinders, after the cement, sand and water have been mixed into a batter. Then add more water to readjust the liquid content of the batch. It is customary when recommending the proportions of cement, sand, and aggregate for mixing a given class of concrete to use three figures, as 1:2:5.

The body of a discarded wheelbarrow set into the top of a sturdy, knee-high stand built of scrap wood makes a handy set-up for mixing concrete required for ordinary home repair jobs. Its convenient height eliminates the back strain that goes with





Two types of collapsible inner forms for casting concrete. No nails are used except where indicated

mixing on the ground, and if used indoors the floor under it can be swept up regularly. Of course, a wooden box can be substituted for the wheelbarrow body.

Mixtures recommended for various general types of concrete work are given in the two tables. Either table can be followed accurately by using a box for measuring the amounts of cement, sand, and aggregate in the proportions called for.

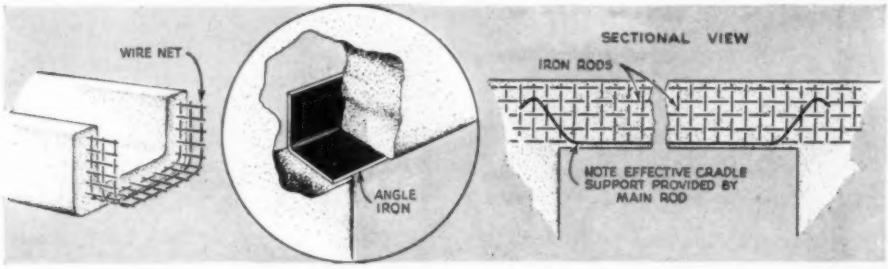
In order to add just the right amount of water to the dry mix, if Table No. 2 is used, it should be added carefully, a little at a time. Meanwhile the mixing should be continued. When the concrete becomes pliable, like a batter, it is ready. Any excess water in concrete reduces its strength. When following Table. No. 1, the water must, of course, be measured beforehand.

Stones of various sizes can be dropped into the form along with concrete when casting abutments such as those supporting the hatch-type cellar doors. To avoid rotting of the wooden sills commonly used as hinge bases for doors of this kind, it is a good idea to eliminate them and anchor the hinges in the masonry.

HOW TO MIX CONCRETE FOR ANY PURPOSE

Type of Work	Table 1			Table 2		
	Cement	Water	Ordinary sand-gravel	Cement	Sand	Aggregate
Class A Concrete exposed to severe action of water, frost, and wear—posts and drives.	1 cu. ft.	4½ gal.	Add enough to make approx. 3 cu. ft. of concrete	1	2	3
Class B Concrete exposed to moderate action of water, frost, alkali, and wear—steps and septic tanks	1 cu. ft.	5½ gal.	Add enough to make approx. 4 cu. ft. of concrete	1	2	4
Class C Concrete protected from action of water, frost, and alkali—retaining walls and foundations	1 cu. ft.	6½ gal.	Add enough to make approx. 5 cu. ft. of concrete	1	2½	5
Class D Low-strength concrete—foundation footings	1 cu. ft.	7½ gal.	Add enough to make approx. 6½ cu. ft.	1	3	6
	1 bag of cement=1 cu. ft.			Add water as required		

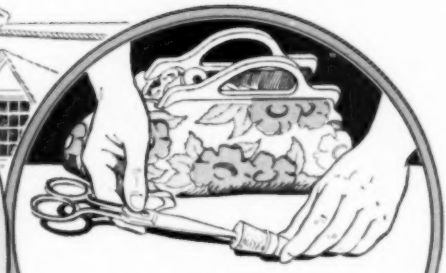
Use 1 part cement, 3 parts sand, 1 part lime as a mortar for brick, tile, stone. Use a 1:2 mix for the finishing coat on two-course work



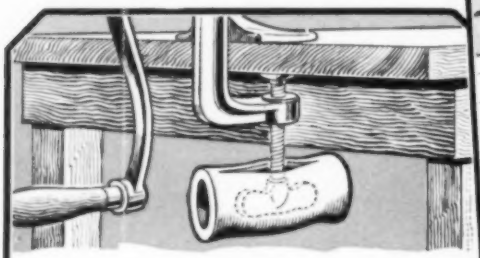
Methods of reënforcing concrete: (1) tanks and troughs, (2) over openings, (3) when used for beams

KEEPING THE

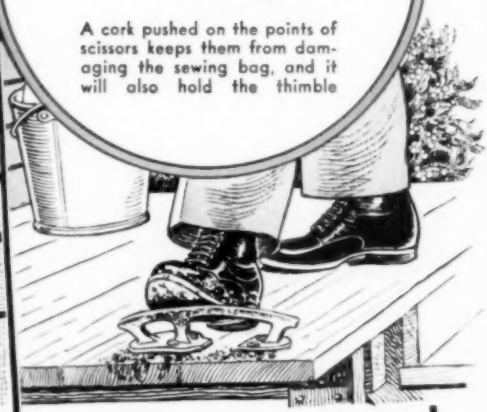
By bending the hook of a wire coat hanger into the shape of the letter "R," you can snap it on the clothesline, and the wind cannot blow it off



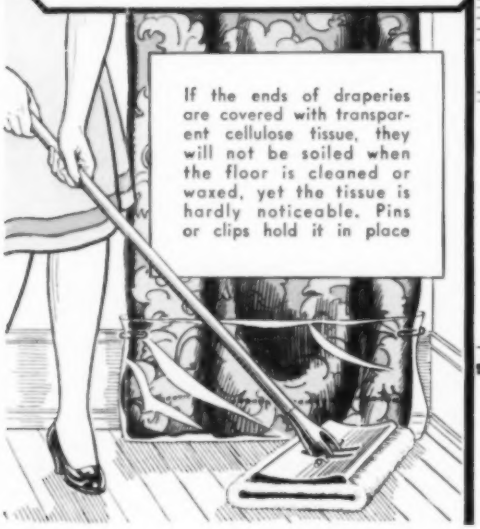
A cork pushed on the points of scissors keeps them from damaging the sewing bag, and it will also hold the thimble



Tightening the thumbscrew on the food chopper is made easier by cutting a slot in a piece of garden hose so that it fits over the screw



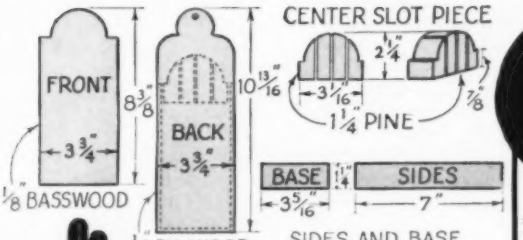
Discarded ice skates may be used as foot scrapers on farmhouse porches or other places where appearance isn't important



If the ends of draperies are covered with transparent cellulose tissue, they will not be soiled when the floor is cleaned or waxed, yet the tissue is hardly noticeable. Pins or clips hold it in place

To prevent a small child from opening drawers in the kitchen and obtaining knives and other implements when mother is not around, drop a stick through the handles and he will be safe

HOME SHIPSHAPE



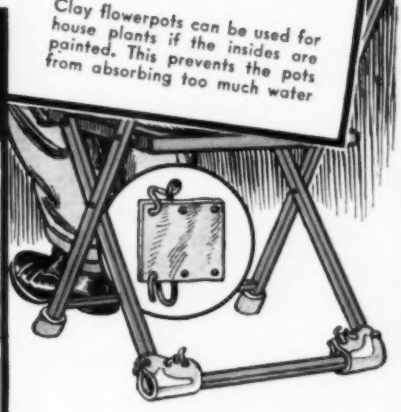
This knife rack accommodates five knives of sizes usually found in the kitchen. Assemble with casein glue and decorate the front with a decalcomania. Attach the rack over the table or in another convenient place

Large corks, drilled and slotted, may be fitted over the bail of a cooking kettle to hold the lid while draining off the water

A diagonal stripe painted across an encyclopedia set immediately shows when a volume is misplaced

Clay flowerpots can be used for house plants if the insides are painted. This prevents the pots from absorbing too much water

The water-heating coil won't wear out as quickly if T-connections are substituted for elbows. The plugs can be unscrewed and sediment removed with a bent wire



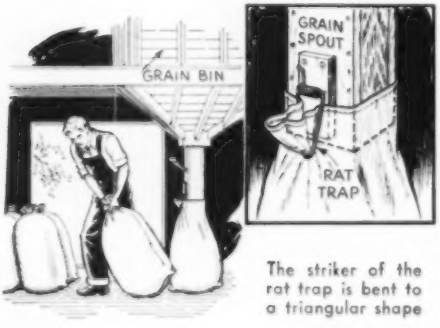
Leather "shoes" will keep the rear legs of metal folding chairs from damaging the carpet or floor. Rubber crutch tips can be fitted over the front legs

Printing Ink Applied with Grease Gun

TO SIMPLIFY the use of a cheap ink for posters and other rough printing, one printer keeps the ink in a grease 'gun, the tip of which is fitted with a short length of rubber tubing. As the ink is forced from the gun, the hose is employed to spread it smoothly over the plate.—G. E. HENDRICKSON.

Rat Trap Holds Grain Sack on Spout for Filling

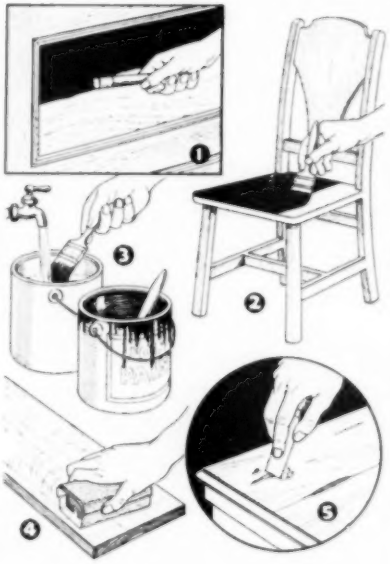
FILLING sacks of grain from an ordinary grain bin can be hastened by making use of the method illustrated for holding the sack on the spout. A large rat trap of the ordinary "back-breaker" type is nailed on one side of the end of the spout after the striker wire has been bent to the triangular shape shown. To fasten a sack, lift the elongated striker and pull the lip of the sack through it. The spring tension will keep the sack in place—E. G.



The striker of the rat trap is bent to a triangular shape

What's Wrong IN THESE SKETCHES?

INEXPERIENCED painters make many mistakes, some of which are illustrated below. Can you spot them? Figure 1 shows how an amateur started to paint some panels on his sun porch. In Fig. 2 he is painting a chair. He always makes a practice of washing his brushes after use and keeping them in a can of water (Fig. 3). In Fig. 4 he is sanding the top of a small table. Whenever he finds bad dents that have to be filled with putty, he applies the putty as in Fig. 5. His mistakes are explained below, but try to discover them for yourself.



1. The moldings should be run in first from corner to center; then cut in the panels with left-to-right strokes. The brush is too small and improperly held. Hold it as in Fig. 2 for proper balance and lexion of bristles and wrist. 2. Start with the underparts first, and with the surfaces that are seen the most. 3. Clean brushes in the proper solvent and put away in a brush keeper (not water) so the bristles hang clear of the bottom of the can. 4. Don't use a whole sheet of sandpaper wrapped around a block, but a quarter sheet preferably held on a sponge-rubber-faced block about 1½" by 3" by 5". Sand in straight lines only with the grain of the wood. 5. Select a flexible putty knife and use the fingers of the left hand to press down the blade so as to smooth the putty to a flat, level surface. Two hands are needed for this.

$100 IN CASH PRIZES FOR The Ideal Medicine Cabinet

IF YOU were given the job, couldn't you design a better medicine cabinet than the one you have in your bathroom at home? We know you'll say "yes," so we challenge you to try it. And to stir up a little friendly competition, we will award the following cash prizes for the best designs submitted:

FIRST PRIZE	$50
SECOND PRIZE	25
THIRD PRIZE	15
FOURTH PRIZE	10

Plan the cabinet to hold standard remedies, such as those in the accompanying list, as well as toilet articles, prescriptions, and other essentials. It may be of any materials, with or without illumination, but should be of reasonable size and of such construction that any competent amateur craftsman could build it without difficulty.

Make a clear, dimensioned pencil drawing or sketch of the design, and prepare a list of materials and brief description. If you have actually built the cabinet, send a good photo as well. Mail your entry to the Contest Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, to arrive on or before November 30, 1940. The contest judges will be the editors of this magazine, whose decision will be final. No entries will be returned. In case of ties, each tying contestant will be awarded the prize tied for. The contest is open to all except employees of this magazine.

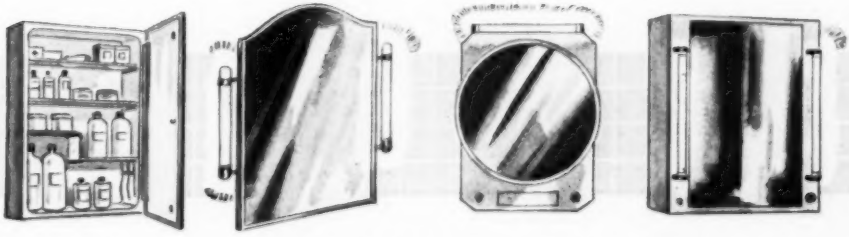
WHAT THE FAMILY MEDICINE CABINET SHOULD CONTAIN

The following list is based upon recommendations of the United States Department of Labor in a booklet, "The Home Medicine Cabinet":

Toothbrushes • Tooth paste, powder, or liquid • Scissors
Shaving essentials • Rubbing alcohol • Boric-acid powder
Tincture of iodine • Aspirin • Aromatic spirits of ammonia
Tannic-acid powder • Petrolatum • Sirup of ipecac • Tweezers
Dental floss • Sodium bicarbonate • Clinical thermometer

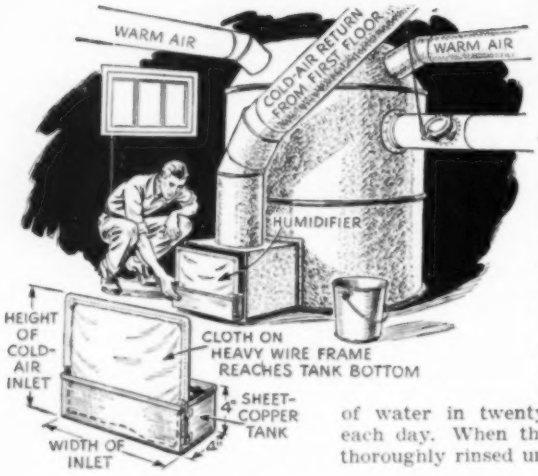
FIRST-AID DRESSINGS: 12 assorted bandages, roll of sterile gauze, roll of adhesive plaster, roll of absorbent cotton

ONE OF THESE: Mineral oil, mineral-oil emulsion, cascara sagrada, milk of magnesia, sodium phosphate, castor oil



The cabinet may be either the built-in or the plain wall type, and with or without lighting fixtures

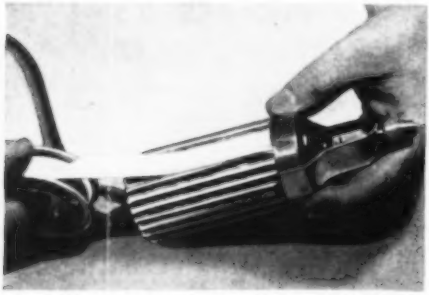
Humidifier Moistens Air and Reduces Dust from Hot-Air Furnace

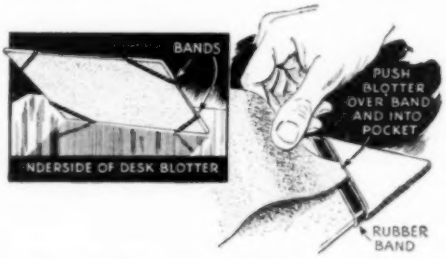


MANY homes with warm-air furnaces suffer from a lack of moisture and get plenty of dust from shaking the ashes, especially when there is a cold-air inlet or return equipped with a slide to vary the amount of cold air taken in off the floor. When this slide is open, ash dust can circulate throughout the house. To stop this, I made a humidifier as shown with an absorbent and porus cloth screen. It has been very successful and evaporates over 2 gal. of water in twenty-four hours. The tank is filled each day. When the cloth cover becomes dirty, it is thoroughly rinsed under a faucet.—ARTHUR STROHM.

Corrugated Cardboard Gives Cool Grip to Hand Grinder

INEXPENSIVE hand motor grinders are usually not equipped with forced ventilation and therefore become hot when used continuously. A cool grip can be added by taping corrugated cardboard around the handle.



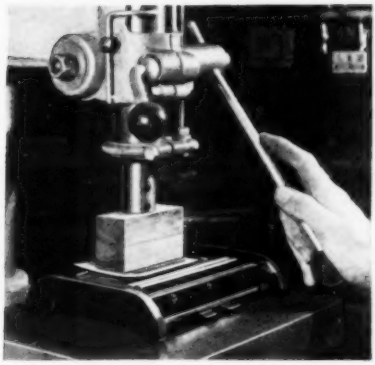


Nonslipping Desk Blotter

A HEAVY rubber band placed across each corner of a desk blotter will keep it from slipping on a smooth desk top. To install the bands, remove the blotter from its backing and snap an elastic across each corner; then slip the blotter back into the corner pockets. The bands are covered by the blotter on the top and are exposed only on the underside.—CARL L. SAWYER.

Metal Machinery Stand Adjusted to Suit Uneven Shop Floor

METAL stands for woodworking machinery that have legs of the type shown can easily be adjusted to rest solidly on uneven concrete floors. A short $\frac{1}{4}$" diameter roundhead bolt is inserted in the hole of the offending leg and screwed into a nut on the underside of the foot far enough to make the stand rest firmly on the floor. The upper nut is then tightened to lock the bolt in place. Sometimes it is wise to place a small square of sheet metal beneath the bolt, particularly if the wood floor is soft, or the concrete crumbly. This method of adjustment insures a steady bench.



Small Printing Matrices Made on a Drill Press

OWNERS of small printing presses who also have access to a workshop drill press can use the latter to make matrices or "mats" of type or cuts. Place the form containing the type on the drill-press table. Wet a piece of mat stock and lay it over the type, followed by a pad of rubber (cut from an old inner tube) and a wooden block. Center the block and type beneath the chuck and feed the spindle down with considerable pressure.

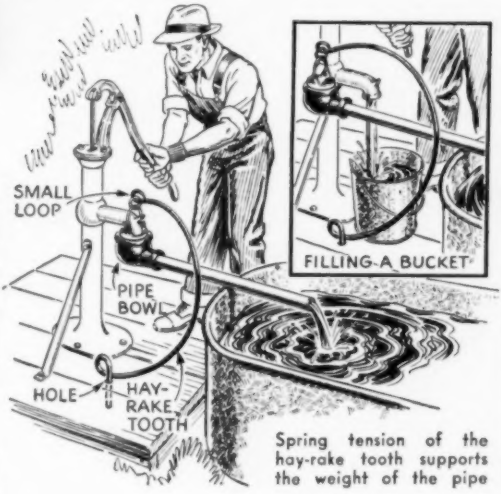
If the first application of pressure does not make an even, clean-cut impression, the mat can be slipped back in position over the type, and the operation repeated a second or even a third time.—VERNON B. CASE.

New Pour-Top Jars Hold Screws and Nuts

IF YOU are able to lay your hands on empty glass-jar containers of the new type that are equipped with pour-top covers, you can use them to advantage for holding a selection of nuts, screws, and other small shop materials. The large spout works like those commonly found on boxes in which table salt is sold. The covers screw on the jars.

Tooth from Hay Rake Holds Pipe Under Hand Pump on Farm

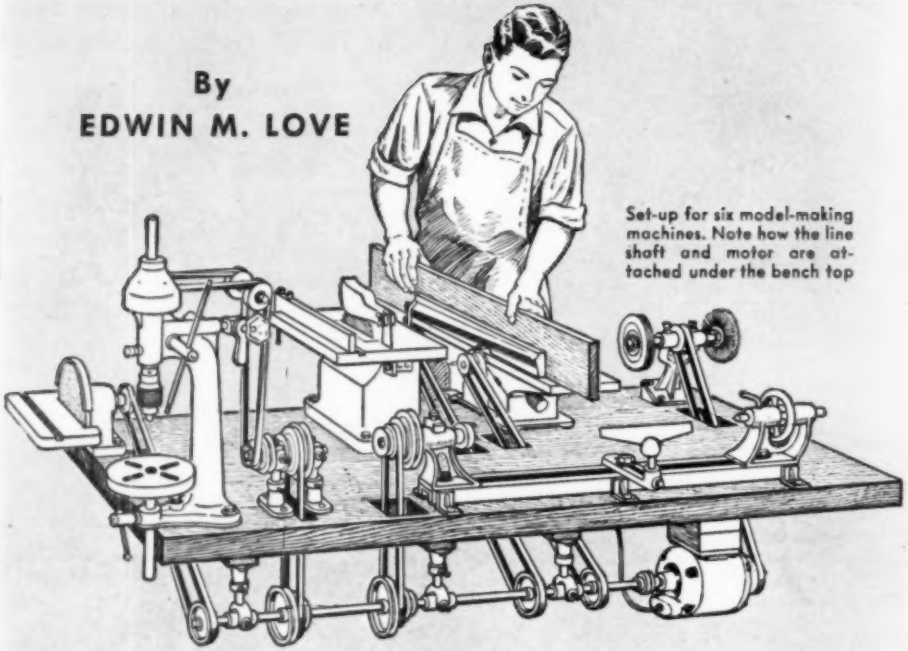
TO HOLD the tank-supply pipe under a pump spout in such a way that it can be instantly attached or released, a discarded spring tooth from a hay rake may be used as shown. Bend a loop in the end so that it will engage the bail of the pipe bowl. Anneal the end, if necessary, to do this. Then drill a hole through the pump platform to receive the opposite end of the tooth.



Adhesive-Tape Strips Strengthen Weak Sections of Stencils

WHEN you purchase a new paper stencil, inspect it carefully for narrow "ties." These have a tendency to break and fall out, so cut strips of adhesive tape of the correct width and reënforce them as shown. This helps to make the stencil last indefinitely.

By
EDWIN M. LOVE



Set-up for six model-making machines. Note how the line shaft and motor are attached under the bench top

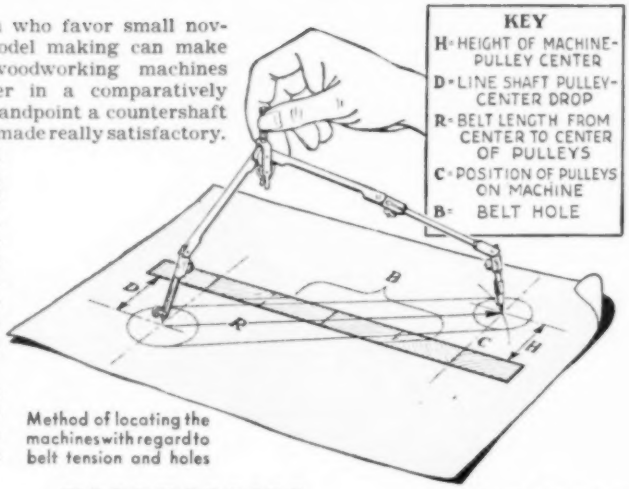
Workshop Layouts

FOR SMALL WORK and MODEL MAKING

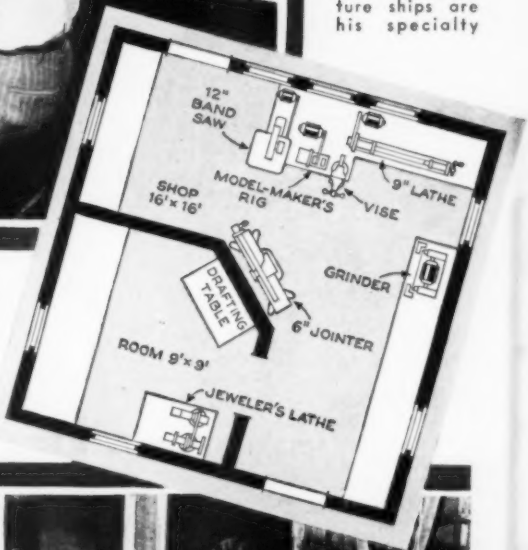
AMATEUR craftsmen who favor small novelty work or model making can make use of light woodworking machines grouped together in a comparatively small space. From their standpoint a countershaft and line-shaft drive can be made really satisfactory.

No matter how small the projects themselves may be and how much of the work is done by hand, it is always more convenient and economical to use machines in cutting standard stock to the smaller sizes required. Plans for shop equipment should keep this in view.

Light machines, driven from one or perhaps two motors, perform well on platforms or single



Method of locating the machines with regard to belt tension and holes



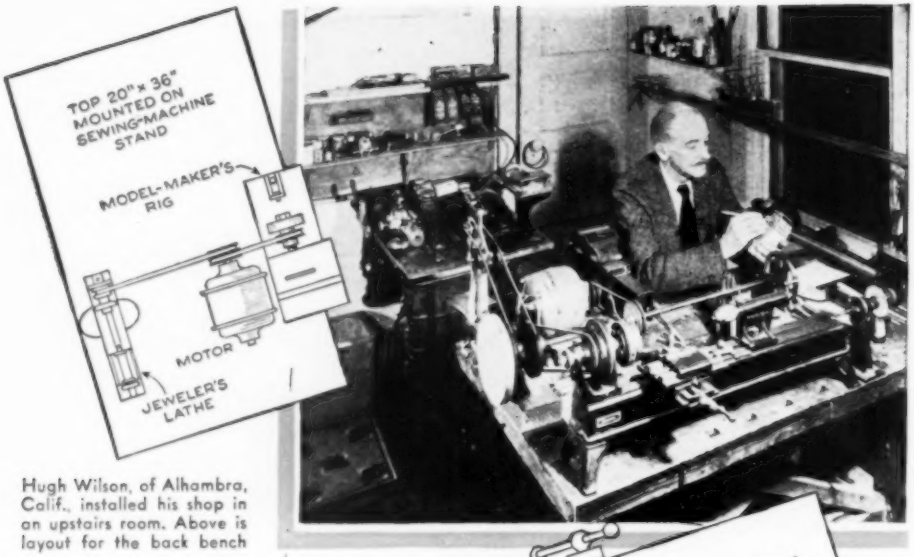
Charles M. Allan, Alhambra, Calif., does detail work and drafting in a small room partitioned off from his shop. Below, how the machines for model making are arranged and, at bottom, Mr. Allan at work in his shop. Miniature ships are his specialty

benches; and where a line shaft is used, it can often be put beneath the bench top, thus compressing the layout and saving floor space.

What is a good way to hang a line shaft under the bench top?

The drawing at the beginning of this article shows a handy grouping of six machines. The shaft is below the lathe. Belt tension is adjusted by the hangers, if of the adjustable type, or by shimming their bases if they have plain, solid columns.

The first thing to do is to set the machines roughly in place. Arrange them so that long boards can be passed over the lathe from either saw or jointer and so that wide panels will clear the tops of adjacent machines. The drill-press table rises far enough to let long work clear the sanding-disk table, and the latter, being



Hugh Wilson, of Alhambra, Calif., installed his shop in an upstairs room. Above is layout for the back bench

used only for short material, has plenty of working room.

Now check the belt lengths by looping them over their pulleys and noting the distance from center to center. Mark these values down for later use. Slip the pulleys and hangers on the line shaft, and bolt the hangers to a line. Adjust the end ones so that the shaft turns freely, and then the center one.

As the motor itself has a pulley for driving the polishing head, locate the motor to suit and shim it away from the bench top with wooden blocks. If accurately placed, the motor can be attached to the shaft with a solid coupling, but a flexible coupling is better because it will take care of slight irregularities. The motor must be capable of running in a hanging position.

The location of the machines with regard to belt tension, as well as the position of the holes where the belts pass through the bench top, are plotted as shown in an accompanying sketch. Draw on paper a section of the bench top to any convenient scale; it does not have to be full size. Mark the center of the line shaft (distance *d*) and draw a horizontal line marking the height of the machine pulley (*h*). Set a compass to an arc equaling (to the same scale) the experimental belt length obtained before. Center the compass on the line shaft and strike an arc through the machine-pulley height line.

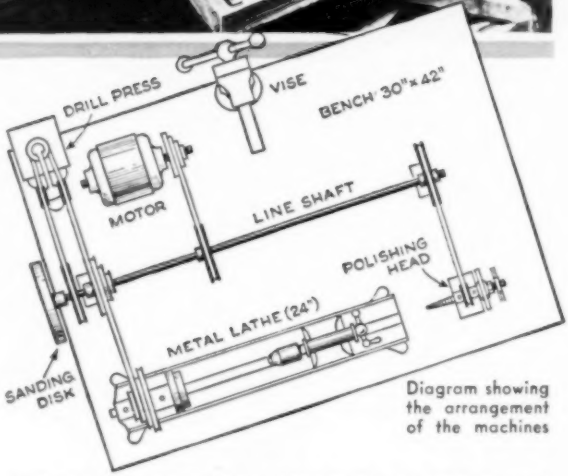


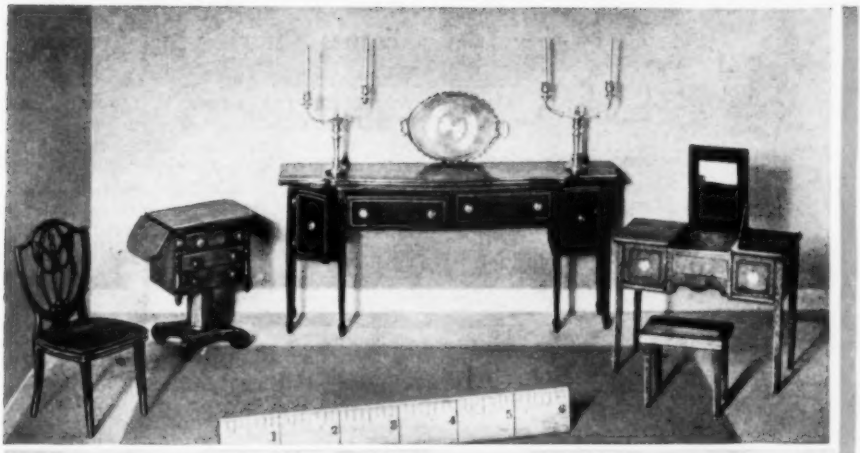
Diagram showing the arrangement of the machines

Draw circles to the same scale to represent the size of the pulleys. Connect them with lines indicating the belt. The position of the hole through the bench is then easily scaled.

When the machines have finally been set in their permanent places, align and tighten the pulleys on the shaft.

Cut a hole under the saw and another under the jointer through which sawdust and shavings can drop. Place a box or, still better, a deep drawer beneath to catch the litter. If the bench is closed in, provide a removable panel or drop door on the countershaft side.

As all belts except the one in use are removed from the machine pulleys, it is well to insert hooks or pegs in the bench top to keep the belts from slipping through the holes.



Model furniture constructed by Mr. Wilson. Every little detail is complete. The drawers slide in and out and the doors open on scale hinges. Note the 6" ruler in the foreground

How should a shop be laid out for model making?

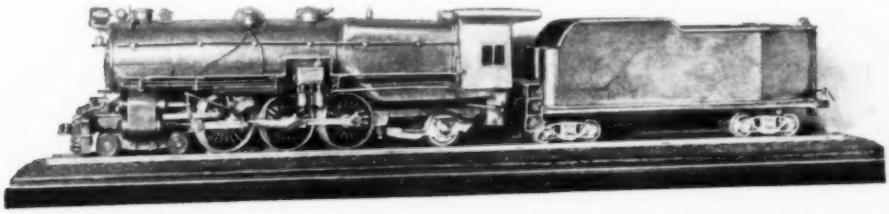
That is so much an individual matter it is hard to give definite rules. Perhaps the best answer is to show two typical shops of experienced model makers.

One shop illustrated is that of Charles M. Allan, of Alhambra, Calif., who started in 1927 as an amateur by building a Spanish galleon model from plans published in POPULAR SCIENCE MONTHLY. Mr. Allan has graduated into a professional whose products are marvels of craftsmanship and sell for high figures. He has provided yacht models for such notables as George Converse; Preston Sturges, the movie playwright; Donald Douglas, of the Douglas Aircraft Co.; and Jascha Heifetz, eminent violinist. Lincoln Ellsworth, the explorer, ordered a miniature of his famous plane, *Polar Star*. Mr. Allan also drew plans for many ship sets in the motion pictures "Barbary Coast," "Hurricane," and "Dodsworth."

As you will see from the plan of his shop, he uses plenty of bench and window space. Along the west wall he groups his band saw, lathe, vise, and model-maker's rig, but the latter, being portable, is usually found near the work at hand. Drafting and small detail work are done in a room partitioned off from the shop, where there is a small bench with a jeweler's lathe and soldering equipment.

Hugh Wilson, another professional model maker of Alhambra, does most of his work in a bedroom. Although a ship-model expert, he now majors in HO locomotives and miniature furniture. His expert craftsmanship and wide experience make the layout illustrated in the drawing well worth studying. For reducing large stock to usable size, he has in his garage a band saw, circular saw, and jointer.

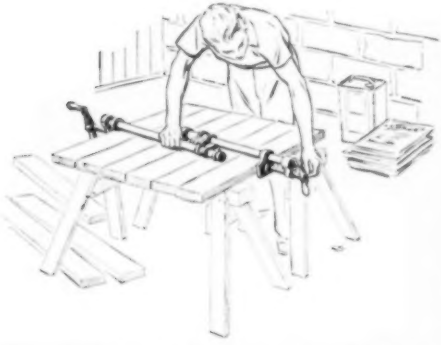
For many of the layouts described in this article and the preceding one, a motor with a reversing switch is required; otherwise the belts on some machines must be crossed.



Mr. Wilson's interests cover many phases of the model-making field. Here is a locomotive he built

Identical Wooden Wedges Cut on the Circular Saw

To CUT any number of identical wedges quickly on a circular saw, make a jig out of scrap lumber as shown. The stock from which wedges are to be cut is placed in the jig, and the whole pushed along the ripping fence, which is adjusted so that the blade just clears the jig. Waste can be eliminated by using precut pieces the width of the wedges, but twice their length. In this case the final cut must be made with a miter gauge set to 90-deg.—H. WALTON.



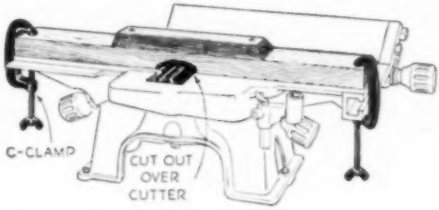
Two Short Clamps Combined to Form a Long One

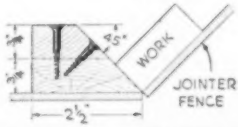
USERS of standard clamp attachments of the type made to fit on lengths of pipe can convert two short clamps into a long one by joining them in the manner illustrated. It is necessary only to give the sliding jaws, which are free to revolve on the pipes, a quarter turn in order to butt them together alongside the work.

Auxiliary Fence on Jointer Forms Chamfering Trough

CHAMFERS of any size can be cut accurately and safely even on a small jointer if a 45-deg. wooden fence is added as shown below so as to form a guide trough. The work sinks down until supported by both fences. It is therefore impossible to cut too deep, all cuts are the same size, and stop chamfers of any length can be made because the work is supported by both sides instead of merely the uncut corners as is the usual practice.

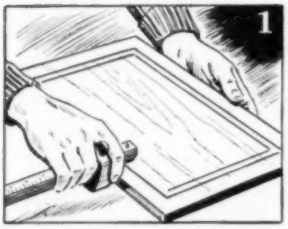
The work can be turned end for end, and the cut can be started at each end of a stop chamfer, thus insuring clean cuts at both ends. Even the ends of narrow boards can be chamfered.—JOSEPH WILLIAMS.

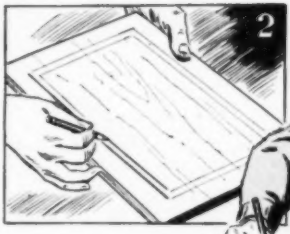


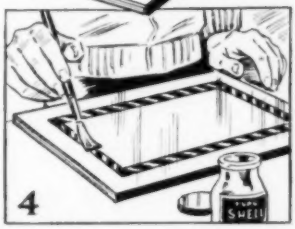


Above, the fence in place. Left, how work is held. Below, fence in use

Colored Pencils Used for Imitating Inlaid Borders on Woodwork







Four steps in decorating a small panel for a furniture project. Because of its simplicity, the method is very popular with boys

AN INEXPENSIVE process which uses colored pencils to produce the effect of inlaid borders on furniture and other woodwork is meeting with success in the Boys' Club and three public schools of Pittsfield, Mass. It has been especially popular in the schools, since the drawing and color work can be done, partly, at least, in art classes. It was introduced by Walfrid T. Victoreen, manual training instructor. The steps are as follows:

1. Mark outlines of border with a marking gauge. 2. Pencil the grooves to make the lines distinct. 3. Trace the chosen design (peppermint-stick stripes are simplest) in light pencil marks, and fill in uniformly with colors. If mistakes are made, they can easily be corrected. Simply sandpaper the surface and start all over again. 4. Finish the entire surface with several coats of shellac and rub down with fine steel wool between coats.

This process can be used on stands, tables, utility boxes, book racks, book ends, smoking and sewing stands, and many other pieces of furniture or craftwork novelties.

WHITE PINE [WOODWORKING]

Color—Heartwood, cream to light reddish brown; sapwood, white to pale ivory.

Properties—Soft, lightweight, and quite strong; close, fine, straight grain; compact, even texture; shrinks moderately; easily worked and nailed; durable outdoors.

Paint—Takes paint very well. Priming coat should be rich in turpentine and linseed oil, second and third coats less so. Paint on sappy spots should be allowed plenty of time for drying.

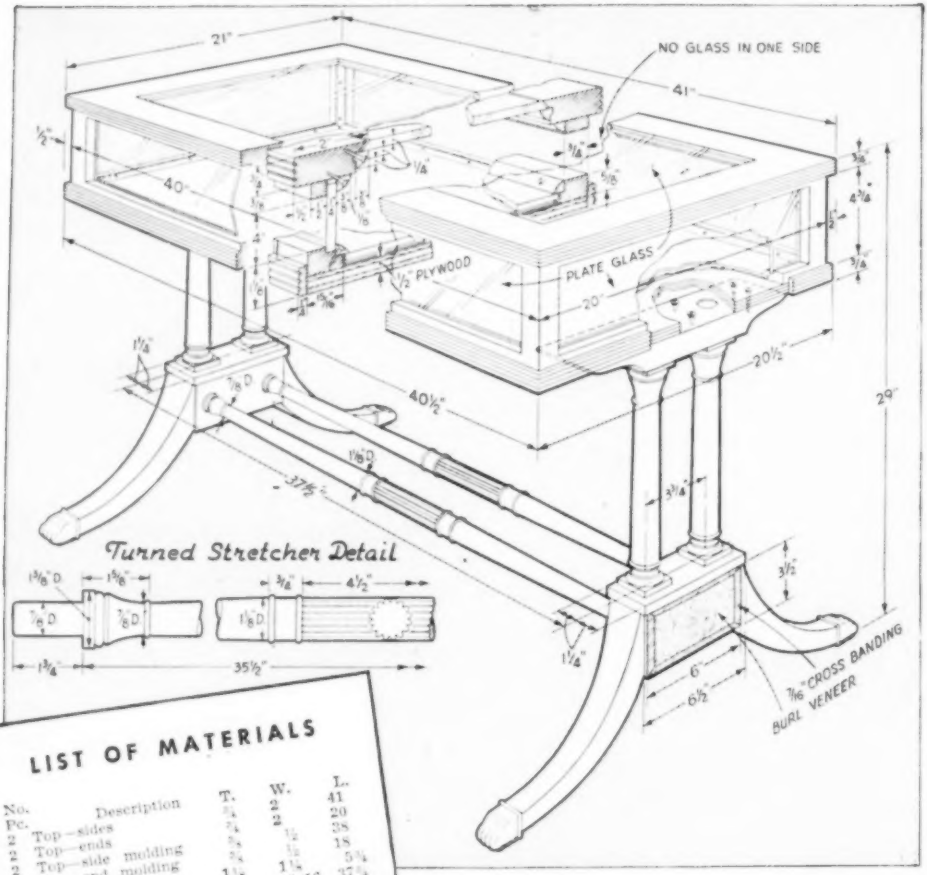
Stain—Takes water or oil stains readily to give good browns. Filler is optional.

Uses—Furniture, boats, building materials, foundry patterns, boxes, and musical instruments.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Designed by
DONALD A.
PRICE

HOBBY TABLE



LIST OF MATERIALS

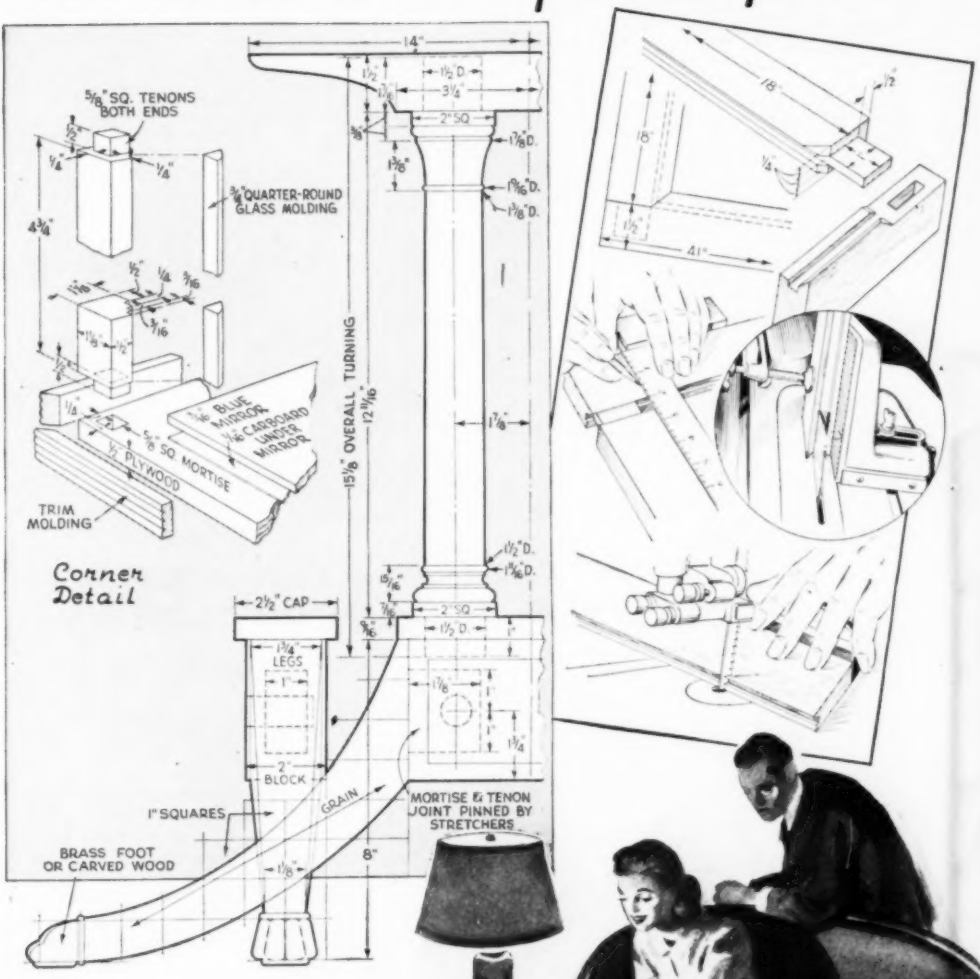
No. Pc.	Description	T.	W.	L.
2	Top—sides	¾	2	41
2	Top—ends	¾	2	20
2	Top—side molding	¾	½	38
2	Top—end molding	¾	½	18
4	Corner posts	1⅛	1¼	5¾
1	Base stop—front	⅛	15/16	37¾
1	Base stop—rear	⅛	15/16	37¾
2	Base stop—ends	⅛	15/16	17¾
1	Head stop—front	¾	½	37¾
1	Head stop—rear	¾	¾	17¾
2	Head stop—ends	¾	½	38½
4	Quarter round—sides	⅝	⅝	18½
4	Quarter round—ends	⅝	⅝	40½
2	Lower molding—sides	¼	¾	20½
2	Lower molding—ends	¼		40
1	Floor—5-ply birch	½	20	14
2	Upper bracket	1½	2	15⅛
4	Legs	2	2	6½
2	Feet block cap	9/16	2½	6
2	Feet block	2	3½	13
4	Feet	1⅞	4⅛	39
2	Stretchers	1⅜	1⅝	

Note: All dimensions are given in inches.

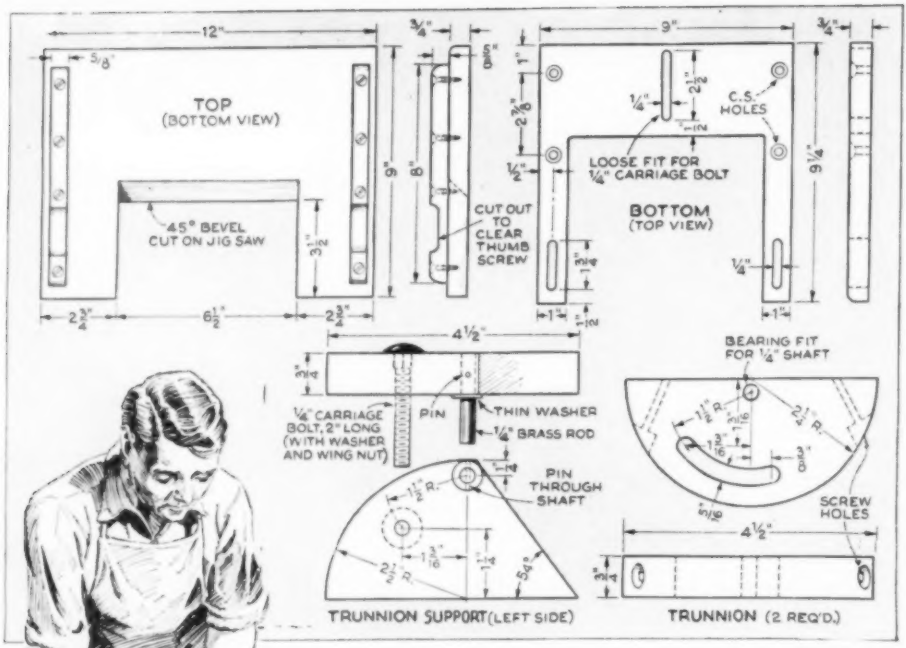
THIS hobby table is designed for displaying small craftwork articles, models, and collections. It is modeled after a Duncan Phyfe mahogany drop-leaf table in the Metropolitan Museum of Art, New York. The top and three sides are of plate glass. One side is left open for access to the interior, but it can be closed with sliding doors if desired. The floor is covered with a blue or rose glass mirror.

The following plate glass ¼" thick is required: 1 pc. 17¾" by 37¾" for the top, 1 pc. 4⅜" by 38" for the side, and 2 pc. 4⅜" by 18" for the ends. The mirror floor is 3/16" by 18" by 38". The top frame

in Duncan Phyfe Style



should be given to the glazier to guide in grinding the bevel of the top glass. Set the glass in plastic cement, which may be obtained colored to match the wood, or natural-colored cement may be shaded with colloidal ground pigment. The mirror floor should be backed up with a sheet of soft cardboard to cushion it.



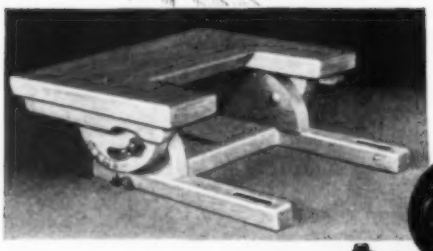
Wooden Disk-Sander Table Can Be Used with Any Small Shop Motor

ALMOST any small motor can be used as a disk sander with the addition of the wooden sander table illustrated. It is easy to build and adjust, accurate, tilts to a full 45 deg., and can be detached quickly when the motor is required for other uses.

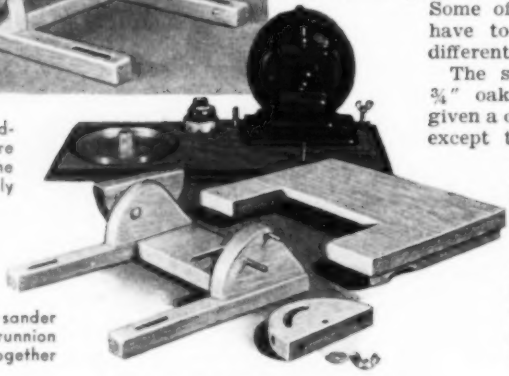
The drawings give dimensions for a table to suit a 6" sanding disk and a motor that is ordinarily used to drive a polishing head. Some of the dimensions may have to be altered to fit a different type of motor.

The stock is well-seasoned ¾" oak. The assembly was given a coat of aluminum paint except the top of the table, which was finished with two coats of spar varnish, waxed, and polished.

Should you care to improve the design still further, the top might be grooved and a miter gauge fitted to it.—R. E. MATHIAS.



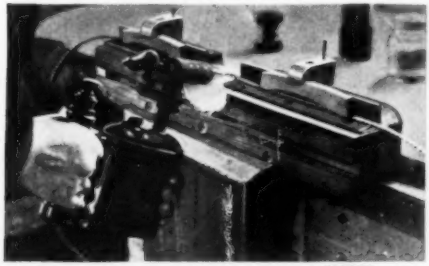
A protractor and adjustable square were used to lay out the scale after assembly

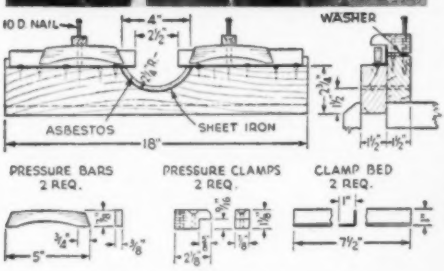


The parts of the sander table, with one trunnion and support put together

Easily Improvised Clamp Holds Band Saw for Brazing

THE inconvenience and delay of sending a broken band-saw blade away for brazing may be avoided by making a clamp as shown below and doing the brazing yourself. Line the circle in the center of the block with sheet iron and asbestos paper to protect the wood. The brazing is done in the usual way, except that with a home-made clamp of this type it is necessary to wind the joint tightly with fine, soft iron wire and push a small brad under the top wires to hold the tapered ends in contact.





The center of the block is lined with sheet iron and asbestos paper to protect the wood from heat

How to Clean Rasps and Wood Files

CLOGGED teeth of rasps and wood files can be cleaned by pouring alcohol over them, setting it alight, and then brushing off the charred particles of wood with a file card.

Miter Gauge of Circular Saw Improved by Adding Handle

THE miter gauge of a circular saw is easier to use if provided with a comfortable handle. Trace the outline of a handsaw handle on a piece of 1" oak or other suitable wood, and leave some extra wood at the bottom. Shape the handle with band saw, rasp, and sandpaper. The exact method of mounting will vary, but in the case illustrated, a piece of steel bar stock was cut and drilled to form a link between the wooden handle and a stud on the gauge.

In this case the handle is held by a steel strip drilled to receive the stud on top of the gauge

Ends of Auger Bits Protected by Cardboard Caps and Corks

WHEN auger bits are not carried in a bit case, they can be protected as shown with short sections of medium or heavy-weight mailing tube, forced over corks or softwood plugs. If cardboard tubing of the right size is not at hand, pieces of hose or rubber tubing may be used. This method protects not only the bit screw, but also the cutting spurs and lips.—W. C. W.

Wiring a Mantelpiece

FOR TWIN LIGHTS and an ELECTRIC CLOCK

MODERN houses frequently have a pair of attractive wall-bracket fixtures over the fireplace and an outlet in the center for an electric clock. When lacking, these can be installed by the method illustrated.

First, bore up from the cellar into the partition just to one side of the fireplace (Fig. 1). A snake wire is next passed up (Fig 2) to make sure the space is open the entire way up to the mantelshelf. Both ends of the snake have a hook formed with a pair of pliers. The upper hook will be caught in the partition with another snake wire inserted from above. At the lower end, a trimmed end of BX cable is wrapped on, just ahead of the hook.

The board usually found at the back of the mantel is removed by driving in the nails with a nail set and gently prying it off. A small hole is made at the extreme left (Fig. 3) through lath and plaster. Another hole is cut just to the right of the first stud. The second snake wire is now pushed up through the latter to make sure the space is open to the point chosen for the light. The hook on the original fish wire, inserted from the cellar, can then be caught by the hook on the end of the second snake and pulled out. Continue to pull until the BX cable is out of the hole sufficiently far to reach the light outlet.

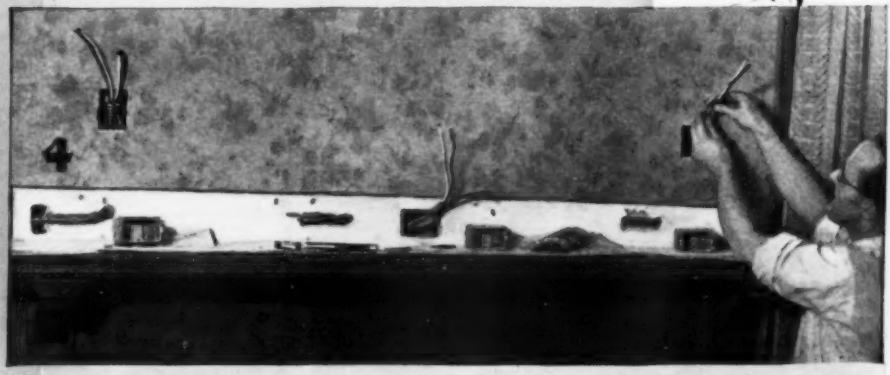
The cable is now carried to openings made in the plaster and lath, corresponding to the locations of the outlets. From the first bracket outlet, a piece is carried to the clock outlet and from there a piece runs to the right-hand bracket opening. Where a stud has to be crossed and no space is found at the back, as was the case here, a slot is made across the face of each stud capable of taking the thickness of the cable. Red fiber bushings are inserted on the ends of each cable as required by the Electrical Code (Fig. 4). Take care to keep all work within the space covered by the backboard.

Install the two switch boxes at the bracket outlets (Fig. 5) with their ears flush with the plastered surface, and use 1" No. 4 flathead wood screws. Make sure the ends of all BX are brought into the boxes through the knock-out armor.

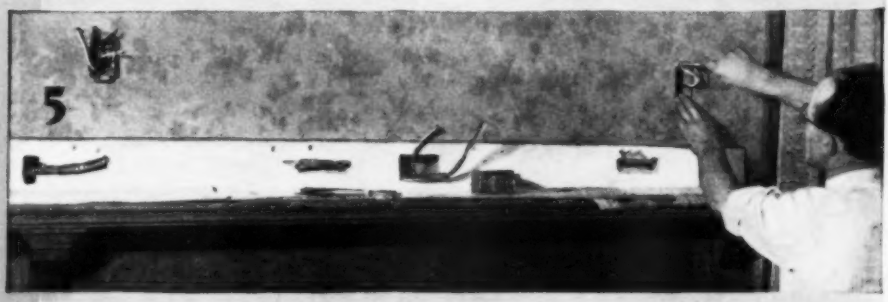
The backboard is prepared by cutting a

By
HAROLD P.
STRAND

A fireplace against an outside wall, like this one, is a little more difficult to wire than one against an inner partition. The extension bit is held at an angle to enter the bottom of the open partition. A snake wire is then passed up and caught with another wire from above so the BX cable can be drawn through



How the wiring is carried across in the space that is to be covered by replacing the backboard

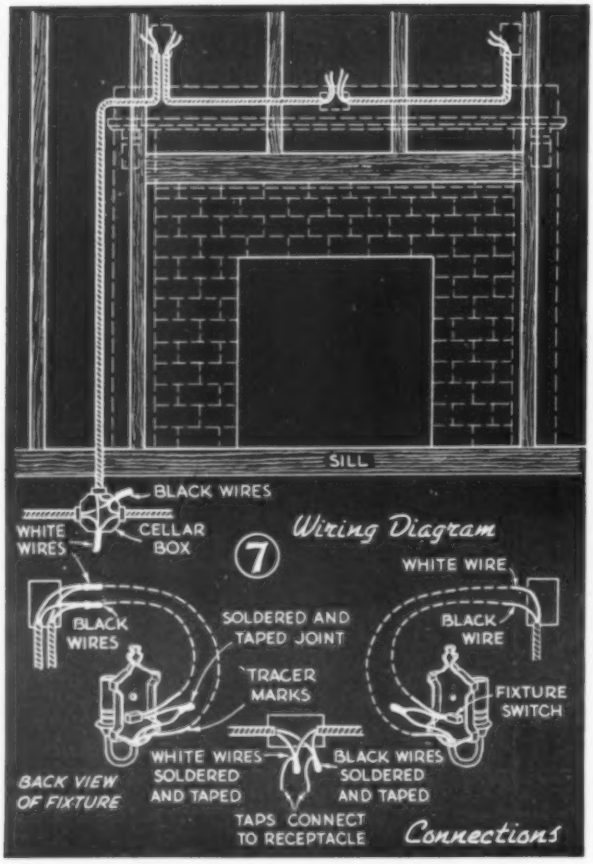


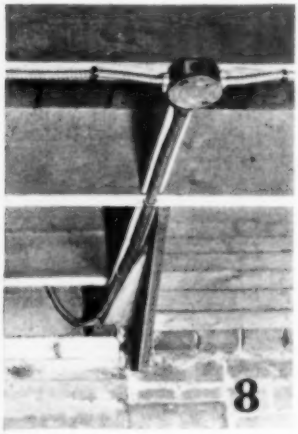
The boxes at the bracket outlets are installed with their ears flush with the plastered surface

The connections are soldered; then the fixture is fastened with a switch-box bar, nipple, and knob

hole in the center to fit a box for the receptacle. The backboard is then replaced, and the box and receptacle are installed. Use ½" flathead wood screws to secure the box. The right-hand bracket in Fig. 6 has been connected, and the left one is having its joints soldered. A switch-box bar, nipple, and knob are used to secure the fixture to the wall. Use both rubber and friction tapes on all joints. The connections are shown in the diagrams (Fig. 7).

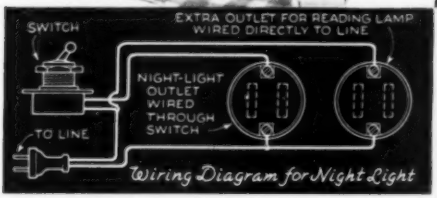
In the cellar, the BX is run to a suitable point where a connection can be made. In this case a cable happened to be running along the bottom of a timber nearby, feeding a base receptacle above. The staples were loosened, and enough slack could be pulled back from the turns, where it was quite loose, so a 3" junction box could be cut in as shown in Fig. 8. In some cases, it might be necessary to run the BX to the cellar light box or perhaps the meter board. If the house wiring happens to be of the open knob-and-tube variety, it might be better to substitute nonmetallic sheathed cable for BX in wiring the mantel, because this material is considered safer to use with open wiring. When using either type of cable, observe the Code rules calling for a running board where timbers are to be crossed. This is first nailed up to the timbers, and the cable secured to it.

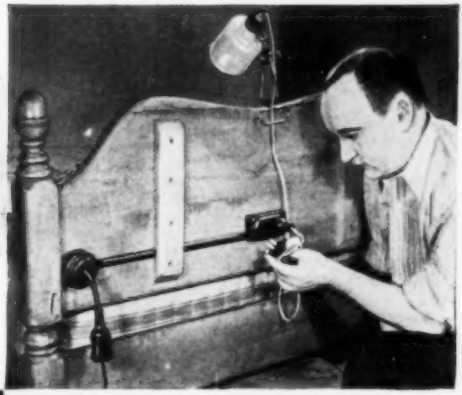




Where BX cable has to be carried across floor beams in the cellar, it is necessary first to nail up what is called a "running board"

Night Lamp Back of Bed Lights Room Faintly


SWITCH
EXTRA OUTLET FOR READING LAMP WIRED DIRECTLY TO LINE
NIGHT-LIGHT OUTLET WIRED THROUGH SWITCH
TO LINE
Wiring Diagram for Night Light



How wiring is attached to the back of the headboard. A hole is drilled for the toggle switch

DESIGNED to give the minimum light required to see faintly around a bedroom, this night light will not disturb another person sleeping in the same room. It is an invaluable aid, for example, in seeing if a baby has become uncovered in his crib.

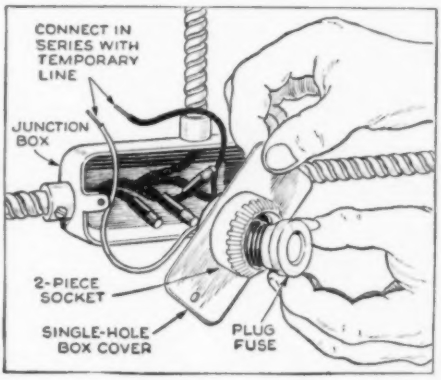
The light is from an indirect 7-watt lamp plugged into a double utility outlet behind the headboard of the bed. A bed lamp is plugged into the other side of the outlet.

The circuit is controlled with a toggle switch, which is mounted by drilling a small hole in the headboard. On the rear of this switch is a round metal box in which all the necessary connections are made and the wires spliced, soldered, and bound with both rubber and friction tape.

Small metal molding is used to protect the wires between the switch and the double outlet. The latter is changed into two separate outlets by cutting one terminal plate into two and filling the space with sealing wax. One outlet is wired through the toggle switch for the night light, and the other or extra outlet is wired directly to the line as shown in the diagram so it can be used for a reading light and operated independently of the night light. The wiring must be of a thoroughly protected, safe type such as would meet with the approval of the Fire Underwriters.—A. L. BUNZICK.

Plug Fuse Serves as Switch in Temporary Circuit

WHEN a temporary electric circuit is needed, both fusing and switching facilities can be provided by the method illustrated. After making the desired connections in an outlet or junction box, replace the cover of the box with one having a single-outlet hole. A blank cover can be cut out to serve this purpose, if necessary. Into this, insert a two-piece porcelain lamp socket which has been wired in series with the temporary circuit. A plug fuse of suitable blow-out rating completes the job. Unscrewing this fuse disconnects the circuit.—J. M.



Portable

COMPLETE DARKROOM FACILITIES COMBINED IN ONE SMALL CABINET

By
J. J. WENNER

COMBINING all the necessary features of a large darkroom into one compact, portable unit, this photo "lab" should appeal to the camera enthusiast who lives in a small apartment or is otherwise limited for space.

A place is provided for every necessary item, yet the cabinet itself is small enough to be stored in a closet or out-of-the-way corner from which it is readily hauled into the darkened kitchen or bathroom so as to be convenient to a sink. Only one electrical connection need be made to the nearest outlet, and you are ready to operate.

The pictures and drawings are intended to convey the general idea of what can be done, rather than specific instructions for building this unit. Every camera fan has his own ideas as to what equipment is most necessary and can readily alter the design to suit his own needs.

The darkroom compartment is of adequate size for loading film into a daylight developing tank, and on occasion can even be used for tray development of cut film. It should be painted with dull-black acid-resisting paint, or, lacking this, a coat of dull black paint followed by a coat of hot paraffin. The sleeves are a double thickness of light-tight black cloth, sewed to form cylinders measuring 5" by 15", provided with elastic, and glued to rings cut from $\frac{1}{4}$" plywood. These rings are then fastened to the side of the darkroom with the cloth between.

A door in front of the cabinet gives access to the darkroom and also provides a handy shelf when opened. A hook or chain holds it level. Felt weather stripping is used to assure that this door will be light-tight.

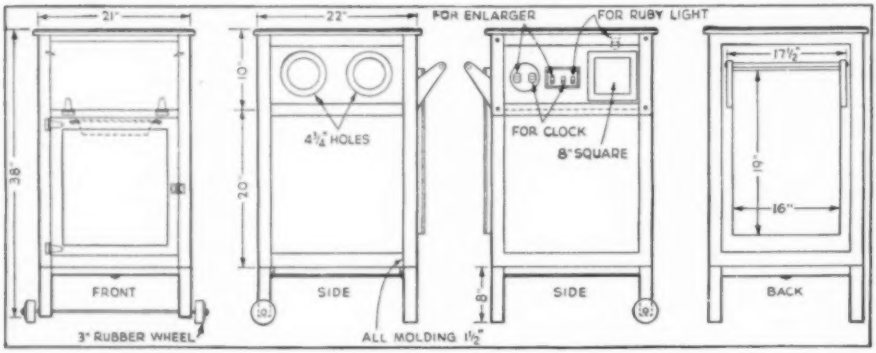


Photo "Lab"

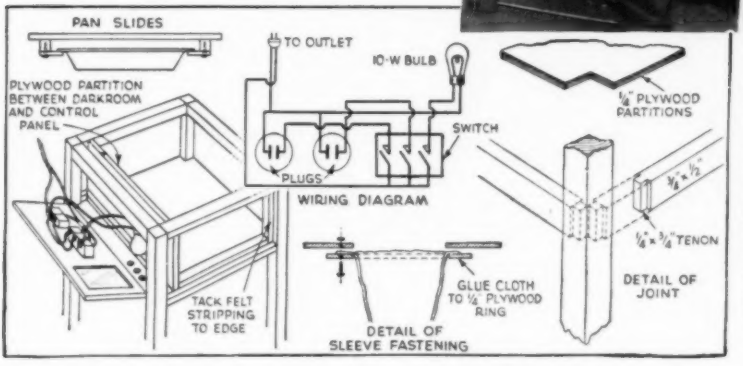
The darkroom proper does not extend the entire width of the cabinet. A $\frac{1}{4}$" plywood partition separates it from the electric service compartment. The outside face of this compartment, also made from $\frac{1}{4}$" plywood, is removable for working on the wiring. The duplex plug, triple switch, and ruby light are mounted on this panel.

The ruby light, used when enlarging, consists of a wood frame holding two sheets of glass, between which two or three sheets of orange crêpe paper have been pasted. A 10-watt frosted bulb is fastened at the top of the compartment behind the window. This small bulb also dimly lights up the storage compartment below through the three holes in the shelf and makes it easy to find articles in the storage compartment when working in a darkened room.

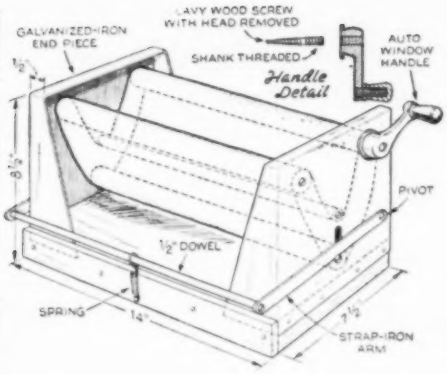
The storage compartment contains shelves for bottles and equipment. The developing pans may be hung in slides at the top of the compartment so as to be out of the way and yet easily accessible. A pocket can be provided on the door for additional equipment, magazines, and books.

Underneath the storage compartment, a small shelf is provided for holding the enlarging easel. On the back of the cabinet, a flat pocket holds the ferrotype sheets and also photo blotters. A bar handle, made from an old broom handle, is provided for wheeling the cabinet, which has 3" rubber wheels on the front legs.

The outside is painted as desired. The inside of the storage compartment should be a light color for greater cleanliness and to aid in finding articles in the dark. The enlarger is mounted in the most convenient manner on top of the cabinet.



Top view, cabinet opened up. Door of darkroom compartment also acts as a shelf. Note enlarging easel pulled partly out of its shelf at bottom. The other photo shows how sleeves are used when loading a developing tank on the inside



The cloth belt is kept stretched by a spring that pulls down the ends of the lower roller

Print Straightener Takes Curl Out of Photos

TO STRAIGHTEN prints, most amateur photographers use makeshift methods. It is, however, comparatively easy to construct a good print straightener.

The one illustrated uses an endless cloth belt that pulls the print under a revolving metal rod. The belt travels over four rollers, three of them cut from broom handles 1" or more in diameter, and the fourth a ½" metal rod fitted with wooden plugs in the ends to receive wood screws.

A strap-iron arm, pivoted at one end, rests on the wood screw in the center of the bottom roller and keeps some tension on the roller, although allowing it to revolve. There is one of these arms at each end, and they are joined with a ½" wooden dowel. A small coil spring draws the dowel toward the base of the straightener. One of the two upper rollers is fitted with an old automobile window handle for easy turning. The cloth belt is a piece of toweling or other closely woven cloth that will not stretch appreciably.

Prints should be run through the straightener as soon as they peel off the ferrotype plates. If you desire to straighten old prints, hold them above a pan of boiling water until they are moistened a little by the steam.—STANLEY JOHNSON.

RETOUCHING PRINTS, PART 3 [*PHOTOGRAPHY*]

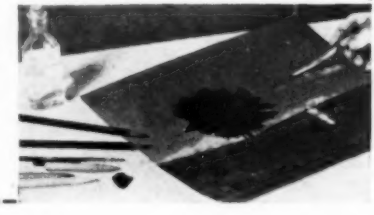
Sepia and Toned Prints. These are best spotted with oil or water colors, since the color shades may be readily obtained by mixing.

Etching. Dark specks or small areas may be etched to a lighter tone with any razor-edged blade. Use a very light scraping action and proceed carefully till the area being worked on matches the surrounding area.

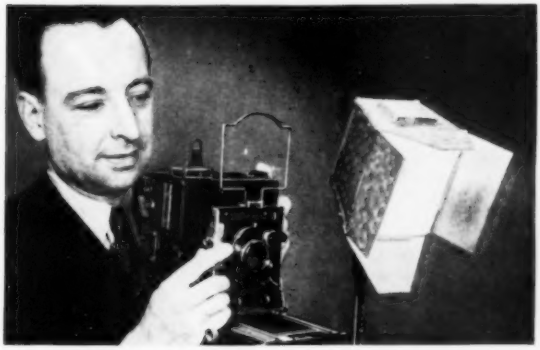
Surface Luster. Where etched areas on the print are noticeable due to the lack of luster, a coating of mucilage or gum dissolved in water will add the necessary gloss. Gum from an envelope flap will do. Experiment on the border of the print till the mixture (when dry) matches the luster of the emulsion. In water-color retouching, the gum water can be mixed directly with the colors.

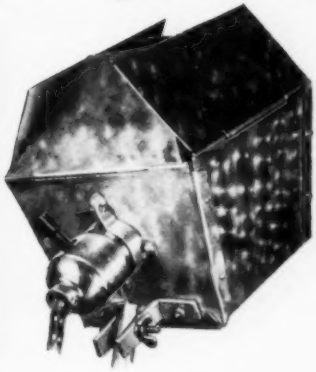
Permanence. Dry spotting, while handier, is not as permanent as either of the two wet methods, since it will smudge more easily.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



Four-Door Reflector Gives Perfect Light Control





THIS photographic lamp reflector has four doors so arranged that when they are partially closed, a spot-light effect may be obtained. Each door may be adjusted to screen light off from any area.

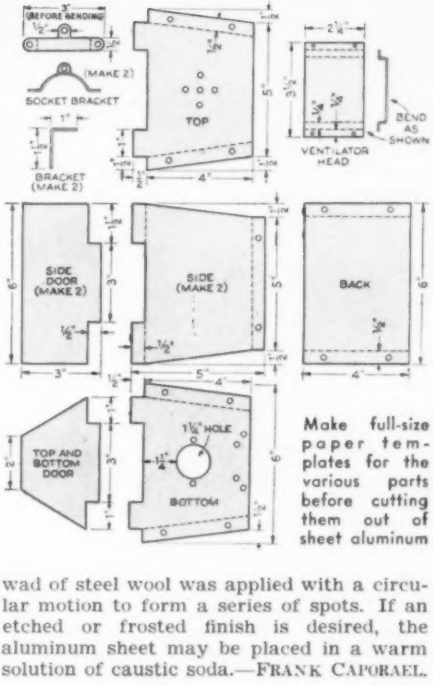
A sheet of aluminum at least 1/32" thick and 12" by 24" is sufficient for the reflector. The one shown was made with only a few hand tools.

It is best to prepare paper templates for all the parts before marking off the aluminum. Do all cutting and drilling before assembling the parts with 1/8" aluminum rivets. In bending the various angles, I used two lengths of angle iron held together with two C-clamps. These acted as a vise.

Two small pieces are cut as indicated to form a collar or bracket for holding the lamp socket. The hinges for the doors are made by leaving protruding tabs and bending them around lengths of drill rod. In this case No. 48 drill rod was used. The ventilating holes drilled in the top are covered with a small light baffle.

Two pieces of aluminum rod 1" by 1/8" are bent and drilled to form brackets to support the lamp. A short length of brass tubing fits between them and is held with a carriage bolt and wing nut.

In obtaining the finish shown, a small wad of steel wool was applied with a circular motion to form a series of spots. If an etched or frosted finish is desired, the aluminum sheet may be placed in a warm solution of caustic soda.—FRANK CAPORAEL.

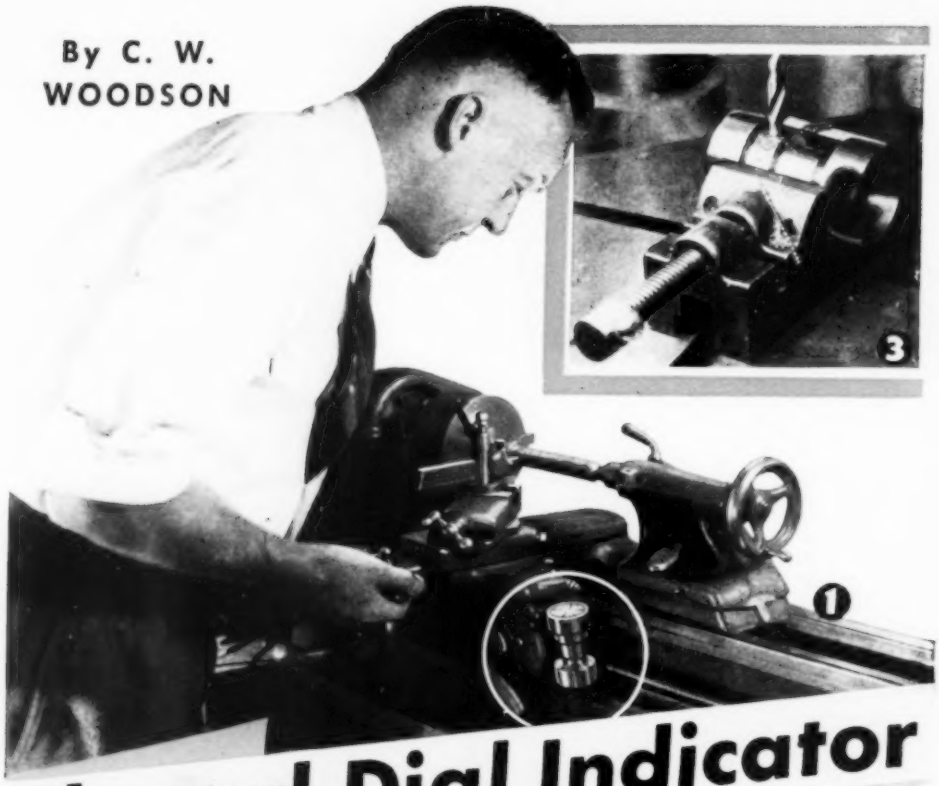


Make full-size paper templates for the various parts before cutting them out of sheet aluminum

Paper Clamp Supports Thermometer in Tray

MANY amateur photographers prefer plain glass thermometers, but these are particularly difficult to use when testing the temperature of solutions that have already been poured into trays. One excellent way of supporting such a thermometer in a developing tray is to utilize a large spring paper clamp. All that is necessary is to enlarge the holes in the clamp slightly to fit the glass tube. The clamp rests on the table and against the rim of the tray, but is not attached, so the thermometer may be easily removed.—G. H.

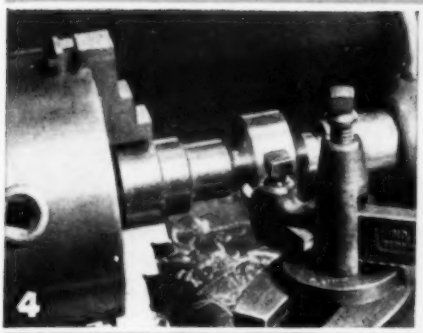
By C. W. WOODSON

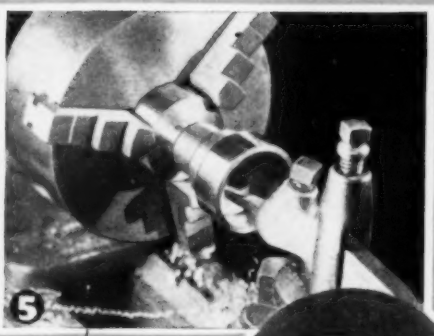


Thread Dial Indicator for the Lathe

THREAD cutting in a wide range of pitches and diameters can be done on a small screw-cutting lathe. The coarser pitches require a number of cuts to complete the thread groove, and in this operation the tool must be returned to the starting point for each successive cut. There are two ways of doing this: First, by reversing the lathe, which on long threaded work is quite slow. Second, by using a thread-chasing dial or indicator that will allow the carriage to be disengaged from the lead screw, returned rapidly by hand, and re-engaged so the tool will follow the original cut.

Building a chasing dial of this type is an interesting and instructive project, especially as the work can all be done on the lathe itself. The indicator shown in Figs. 1 and 2 is made from cold-rolled steel. The shell or body (Fig. 8) is turned from a solid bar as in Fig. 4, carefully smoothed with a fine file, and polished bright with a strip of emery cloth.



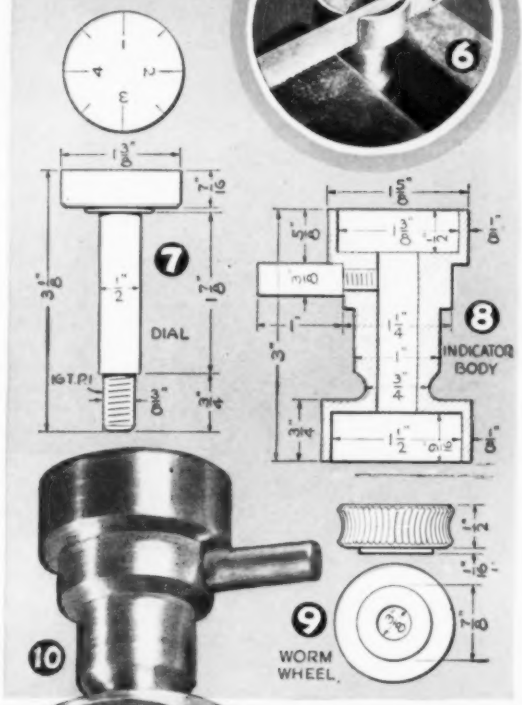


The shaft hole is then drilled and counterbored (Fig. 5) to receive the dial on one end and the worm gear on the other. Figure 6 shows a portion of the lower wall being cut away to allow the worm gear to mesh with the lead screw. This opening was filed to shape with a large, round file to fit snugly around the lead screw.

The hole for the supporting arm is being drilled in Fig. 3. It is later tapped to receive the arm, which is then made up and screwed tightly in place.

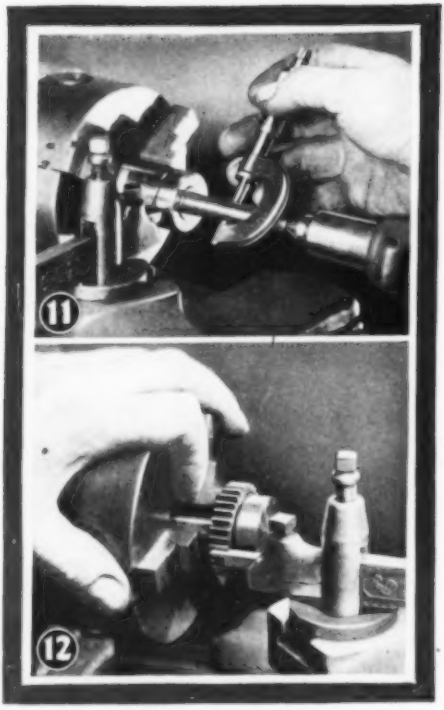
The dial and its shaft are cut from a solid bar as shown in Fig. 11 and brought to the dimensions in the drawings (Fig. 7). The face of the dial is graduated in eight divisions, four of which are numbered.

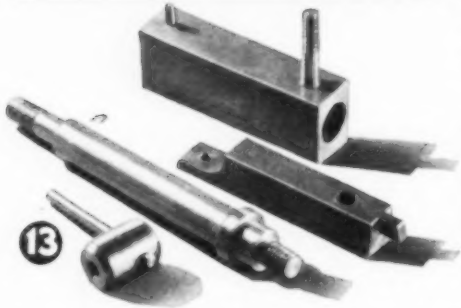
These indicating lines can be engraved on the dial with a sharp-pointed lathe tool laid on its side. The dividing is done by a 32-tooth lathe gear slipped over the shaft. Use the lathe tool as a stop as illustrated in Fig. 12. The line is then engraved by drawing the pointed lathe tool across the face of the dial with the cross-slide screw. The work is advanced four teeth of the dividing gear, again using the lathe tool as a stop, and the operations repeated. The four main divisions are numbered as shown in Fig. 7, and an indicating mark is also stamped on the edge of the shell as shown in Fig. 15.



The worm wheel (Fig. 9) has the following diameters: outer, 1.437"; throat, 1.353"; pitch, 1.273". For cutting the 32 teeth on the blank, a dividing fixture is needed. In this case, a suitable fixture was made as shown in Figs. 13, 17, and 18 to the dimensions given in Fig. 14. A 32-tooth lathe gear was mounted on one end, for dividing (Fig. 18), and the gear blank was attached on the other end.

The fixture is clamped in a vise mounted on the cross slide of the lathe. This is mounted at a slight angle to obtain the spiral in the gear teeth, which are then





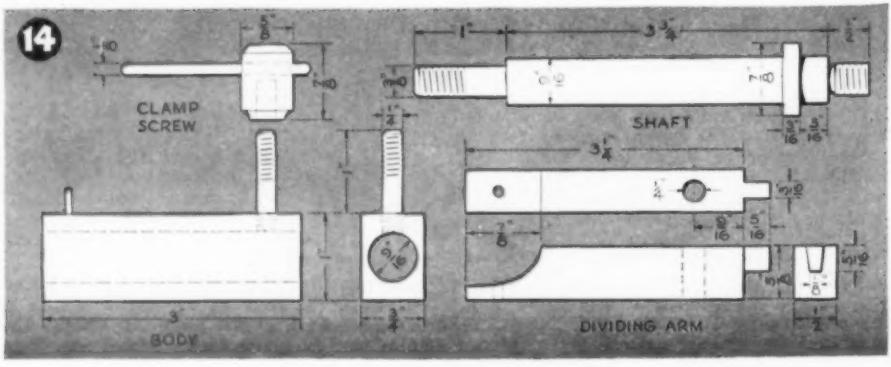
roughed out with a small milling cutter mounted on a mandrel as in Fig. 19. After each tooth is cut, the dividing arm is raised, the gear advanced one tooth, and the operations repeated until all the teeth are roughed out, ready for hobbing.

A serviceable hob was made for this particular job from a $\frac{7}{8}$" N. F. tap. After being annealed, this was turned smooth to $\frac{3}{4}$" in diameter; and new Acme threads, eight to the inch, were cut as in Fig. 20, exactly duplicating those on the lead screw of the lathe. The new threads were then backed off, for clearance, with a fine file, and the hob was rehardened and drawn.

Figure 21 shows the hob mounted in the chuck and supported by the tailstock of the lathe. The gear is mounted to revolve freely. It must be set at a slight angle (high on the left side) for cutting the gear teeth spirally to fit the pitch of the lead screw. The cross-slide screw is used to feed the gear to the revolving hob, which furnishes the motion to the gear as the teeth are being cut. When the gear has been brought to the required dimensions so that it will mesh perfectly with the lead screw, the various parts can be assembled, ready for use.

In cutting threads with the indicator, each line on the dial represents $\frac{1}{2}$" of carriage travel, so with all even-numbered threads the half nuts on the lathe apron can be closed on any line on the dial. For threads of an odd number, close on any numbered line. For threads involving a half thread per inch, such as $11\frac{1}{2}$ threads, close on any odd-numbered line.

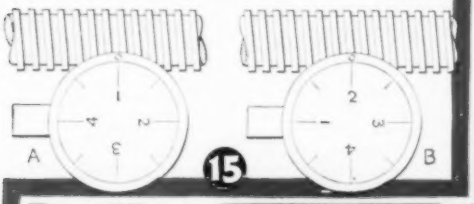
In cutting 11 threads per inch with the dial reading as at *A* in Fig. 15, if the tool were withdrawn from the thread groove and moved back a distance equal to 4 or 5 lead-screw threads, it would not fit into a thread groove in the work. However, if it is drawn back 8 lead-screw threads or a distance of 1", as shown at *B*, this would bring the tool in line with a thread groove 11 threads

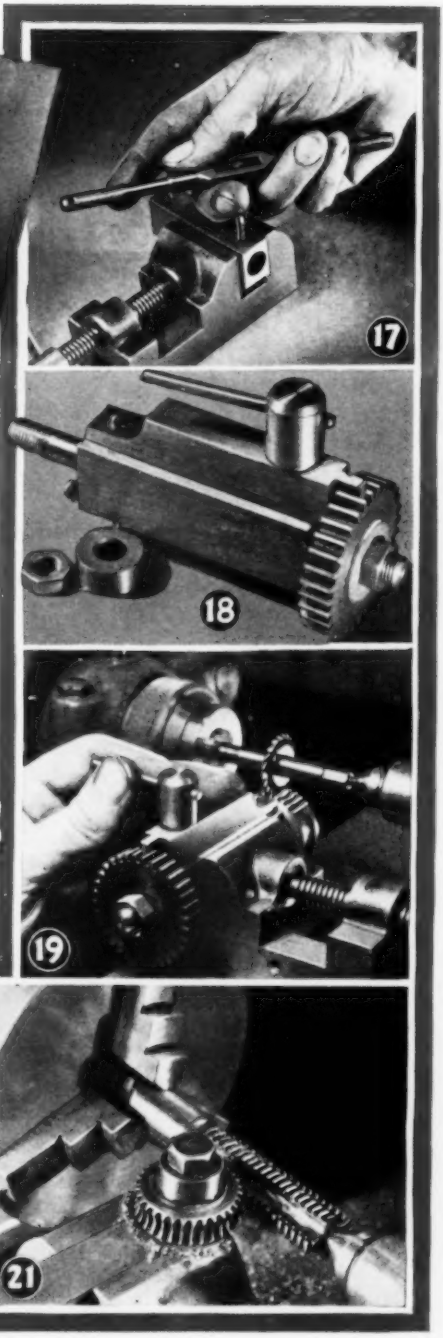


Making a trial assembly of the dial indicator

away. The half nuts can therefore be closed on any numbered line on the dial that represents an inch of carriage travel, and the tool will then follow the original cut.

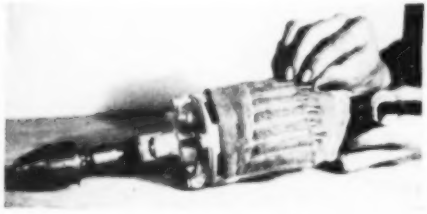
When cutting threads and a half thread per inch is involved, such as $11\frac{1}{2}$ threads, line No. 1 or 3 on the dial, indicating 2" of carriage travel or 23 threads on the work, should be used in closing the half nuts.





Oil Can Has Hook to Hang on Rung of Ladder

SERVICE men who are obliged to grease, oil, and adjust overhead machinery or pulleys will find that a wire hook soldered on the oil-can spout will allow the can to be suspended from a rung of the ladder, thus leaving both hands free when necessary.

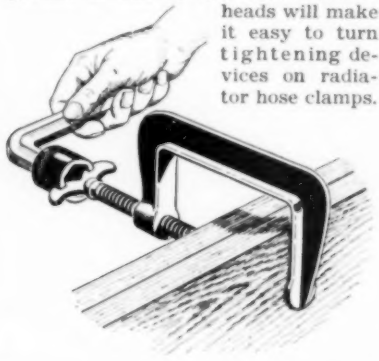


Soft Leather Case Contains Drills for Odd Jobs

BECAUSE he had often lost twist drills while on jobs outside the shop, one mechanic made a holder of thin, soft leather as shown above to strap to his portable drill. Individual pockets were sewed to fit each drill rather tightly. A circular elastic band was sewed to the bottom to hold the pockets to the drill snugly, while a second band, cut in two and provided with a small snap button, was fastened to the flap. The holder is so located on the drill body that the ventilating holes are not covered up.

Slot in Socket Wrench Used for Tightening Wing Nuts

IF A SLOT about $\frac{1}{8}$" wide and $\frac{1}{8}$" deep is ground across the end of one of the larger heads of a socket-wrench set, it forms a tool that will tighten or loosen wing nuts or thumb screws. The most stubborn wing nut may be turned with its aid. A narrower slot ground in one of the small wrench heads will make it easy to turn tightening devices on radiator hose clamps.



Graph Paper Stuck on Square to Aid in Crosshatching

TO INSURE equally spaced lines when crosshatching some part of a mechanical drawing, attach a piece of ordinary graph paper along the working edge of the T-square with cellulose tape. Adjust the perpendicular edge of the angle to each succeeding line of the graph paper.—MASSIMINO RAINONE.

Fine, medium, or coarse crosshatching is obtained by moving the triangle one, two, or three spaces

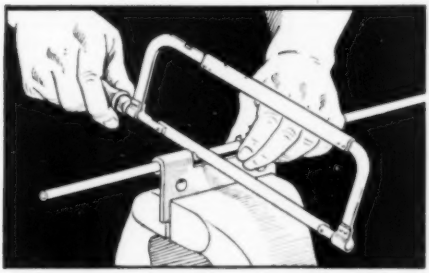
Hand Motor Tool Cleans Small, Deep Holes

AFTER drilling a large number of small, deep holes in some castings, a mechanic found that the quickest way to clean them out thoroughly was to use a pipe cleaner of the correct length in the chuck of a hand power grinder.

Magnetic Ground Contact for Carbon Welder

IN WELDING or brazing large sheet-metal boxes, tanks, and cylinders with a low voltage carbon contact welder, I often experienced difficulty in getting a good ground return because the usual battery clip could not be applied readily at any point. This was overcome by using a large horseshoe magnet from an old magneto.

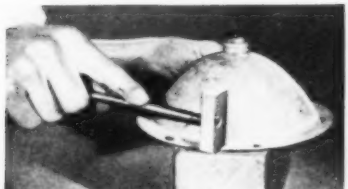
A wide copper strip was attached across the legs as shown below, and the return wire was connected to one of the screws. The powerful magnet holds the copper strip firmly on any iron or steel surface, flat or curved, on which it is placed. If the magnet is not provided with mounting holes, a C-clamp can be used to hold both the strip and the return wire to the legs, as the magnet is too hard to be drilled.—W. C. W.



Half Hinge Holds Tubing While Being Sawed

TO HOLD small copper tubing so that it can be sawed without being crushed, one garage mechanic uses a half hinge placed in a vise as shown. The tubing is inserted through the hinge-pin holes. One of the looped ends acts as a "rest" for starting.

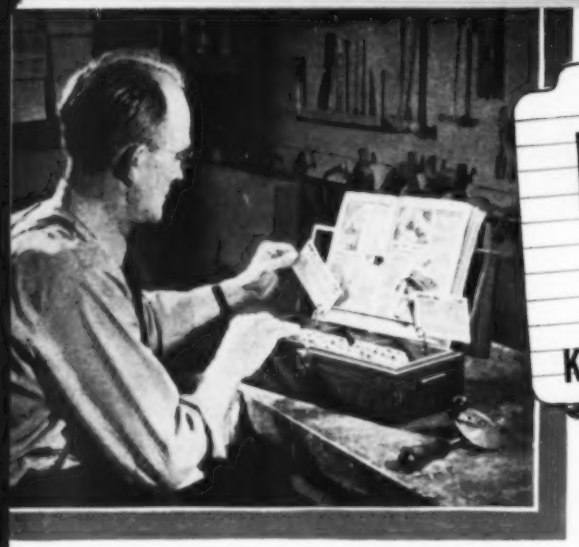
The magnet holds the copper strip on the surface and insures a good ground



Right, the rod sinks into the solder when it is heated. Above, hammering out a kink in a polished surface

Soft Hammer Made of Bar Solder

A USEFUL little soft hammer for removing kinks and dents in polished surfaces can be made in a few minutes from a 2" length of ordinary bar solder and a 10" metal rod. The handle may be attached by threading the rod end and tapping out a hole in the center of the solder or by applying heat from a blowtorch to the rod just above the solder and letting it sink slowly into the head, as shown. When the head has become badly battered, it may be removed and used as solder, and a new section supplied in its place.



File-Card Box

KEEPS SHOP DATA HANDY

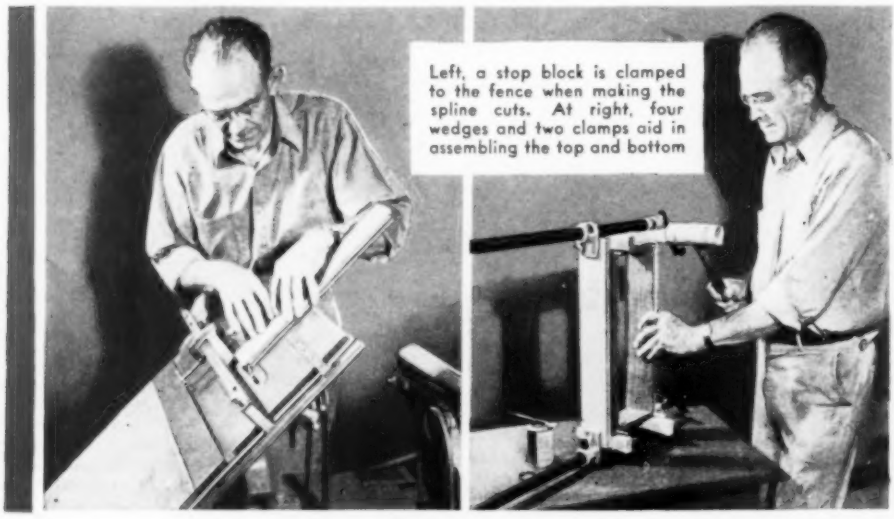
SINCE the introduction of the POPULAR SCIENCE MONTHLY Shop Data File, many amateur craftsmen are keeping reference material in the form of 3" by 5" filing cards. These require some type of file box, and for those readers who take pride in owning the finest available shop equipment, a special filing case for the cards has just been designed.

The box has three compartments for cards, which will hold as many as any reader will be likely to accumulate for years to come. The bottom of these compartments slants upward so that it is easier to find a card. A wire rack is provided to keep in view the card or cards being used, and the same rack also holds a magazine open for ready reference against the open lid.

When the lid is closed, it forms a slanting rest for small drawings or sketches, or a magazine may be laid on it and held open by means of two wire clips, which swing up from behind the box. In addition, these clips will hold several 3" by 5" cards upright.

The original filing case, which was constructed by Frank Hegemeyer, a regular contributor to this department, is a beautiful piece of cabinetwork. The drawings show how he made it, but the box would, of course, be equally serviceable if merely nailed together with plain butt joints.

Construction is begun with the front, back, and sides of the lower part of the box (Fig. 1). The stock is surfaced four sides down to $\frac{5}{8}$" thick and $3\frac{1}{2}$" wide. The top edge is shaped as in Fig. 3, while the bottom edge has a $\frac{1}{4}$" by $\frac{1}{4}$" rabbet for the plywood bottom. Cut the front, back, and sides, and miter the ends, after which the saw cuts can be made for the maple splines.



Left, a stop block is clamped to the fence when making the spline cuts. At right, four wedges and two clamps aid in assembling the top and bottom

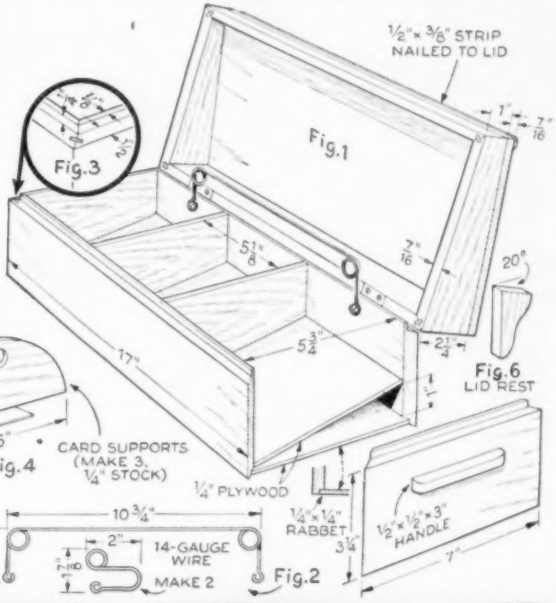
After gluing the lower part, nail the bottom in place. Make the two partitions (Fig. 5) of plywood or hardwood and nail to the false bottom.

The entire lid is cut from 7/16" stock. Fasten the lid top to the frame with 3/16" dowels. The locations of the dowel holes are made to coincide by driving small brads in the top of frame and tapping the lid top on the brad heads. The handles are doweled and glued, and the lid rest (Fig. 6) is screwed on. A small trunk lock is added. Card supports may be made as in Fig. 4.

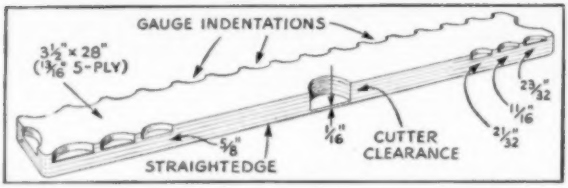
The clips (Fig. 2) are formed by bending wire around a 5/8" metal rod. The inside holder has a one and a quarter bend, and the outside clips have two complete bends.

Use a fine grade of sandpaper for the final sanding, and if an open-grained wood has been used, apply a paste filler. Varnish or lacquer the box, rub down with fine pumice stone, and polish with a rubbing compound. The inside can be stained later. Add rubber-headed tacks to the bottom.

Two wire clips keep the magazine flat and also hold two shop data cards



Left, the dowel holes in the lid top are bored ¼" deep. Note how the lid frame is used as a support. Above, fastening the lid rest to the back of the box. The two wire holders and the handles are already attached



Cutter Gauge and Straightedge for Setting a Spindle Shaper

SHAPER cutters are quickly set to any desired height above the table with this gauge, and it also serves as a straightedge for aligning the faces of the fence if the fence is moved.

Cut a piece of 13/16" five-ply stock and joint the edges. Set a wide cutter with the smallest available collar so as to clear the table 1/16", and cut full depth into the straightedge at the center. This should be cautiously done, with a starting pin in use as for freehand work. With this indentation it is possible to align the fence with a collar, making use of this additional support at the point of cutting.

Make the gauge indentations in steps of 1/32", ranging from 1/16" to ¾". In each case, try the setting first with a test cut in scrap stock. When the indentations are used with the bottoms down, the height of the lower edge of the cutter is gauged; when turned over, the height of the top of the cutter is indicated. If paper labels are pasted on the faces to identify the gauges, the cuts should be made after the labels are attached, so that the thickness of the paper will be taken into account. Protect the gauge with lacquer or thin shellac.

FORGE WELDING, PART 2 *[METAL WORKING]*

1. Do not use coal until it is thoroughly coked. A smoky fire is not a hot fire. The fire should be a solid, white-hot mass of coals; above this body should be about 1" of blue flame.

2. The beginner always forces his blower too much. A low blast is preferable as it forces just enough air through the coal for the fire to consume. Too much blast chills the iron rather than heats it.

3. Do not stick the pieces being welded too low in the fire. There should be at least 1½" to 2" of live coals below the pieces being welded.

4. Never permit the pieces being welded to be exposed to the air while heating. They should be covered with at least ¼" of coals.

5. There is a tendency for the beginner to burn the metal. A careful watch must be kept of the fire. At the first sign of sparks or "stars," the pieces should be turned in the fire and then removed for welding.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

FIRST STEPS IN Decorating Glass WITH A HAND GRINDER

Two tumblers filled with a dark beverage to show off the designs in the glass to best advantage

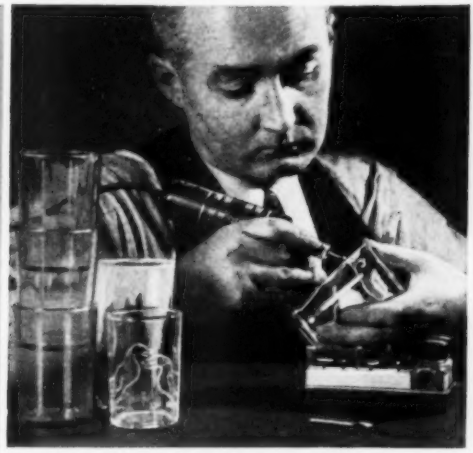
GLASS working of various types is gaining popularity among amateurs. A very simple way to start is to grind designs indelibly into the glass with a small electric hand grinder. This is sometimes called "painting" on glass, although color is not used, of course.

The process offers abundant opportunity for expressing artistic talent, but those who do not find it easy to originate designs of their own can copy or adapt pictures to be found in magazines and books.

For your first attempts, all that you will require in the way of materials are several cheap beverage glasses. The grinding is done with small green silicon carbide abrasive wheels of various shapes.

Plain frosting can be done readily with a wheel shaped like an oversize pencil eraser. Mount the wheel in the chuck of your hand grinder and bring it into contact with the glass, using short strokes such as you would make with a paintbrush. Do not leave the wheel in contact with the glass; try to paint with it. In the beginning no attempt should be made to shape the work by grinding deeply. After some practice, however, you will find it possible to "carve" the glass to any desired depth.

You can learn to follow the lines very easily by purchasing a small



To frost a glass, hold the grinding tool lightly and use it to make short strokes as with a brush

Grinding a design that was fused onto the glass. Below, cutting lines with a thin abrasive wheel

glass already decorated with a colored design that is fused right onto the surface. Carefully grind away the design on the glass, which will leave the same design in an etched or ground finish, which greatly increases the value of the glass.

Once you have mastered this method, obtain a child's ten-cent paint book and from it select a simple outline, such as a duck or a goose. Tear this out and fasten it inside the glass with adhesive tape. Then follow the outline on the outside with a small, round abrasive wheel.

If you make any errors, they can usually be hidden by using a green rubber-base abrasive wheel.

You should have a dressing stone to keep the wheels in shape as they wear down. Often it is cheaper to purchase fairly large wheels and keep them dressed to shape, rather than to buy very small wheels at the start. Some workers use a lubricant consisting of a small lump of camphor dissolved in several ounces of turpentine, into which the wheels are dipped occasionally. This is not necessary, however, with the very simple work just described.

With practice, you will find that a variety of effects may be obtained by this method of grinding.—KENNETH MURRAY.

Right, copying a design attached to the inside of the glass. Below, if the bottom of a glass is not perfectly formed, grind it flat with a glass square and silicon carbide and water

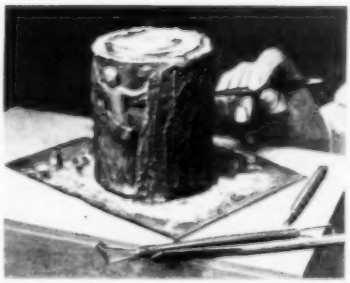
If you are interested in glass working and would like other articles on this subject to be prepared for publication in later issues, please send a post card to the Home and Workshop Department. Mention any glass projects you would especially like to make.

MODELING MATERIAL [FORMULAS]

The following formula for an inexpensive modeling material offers unlimited possibilities to craftsmen, designers, and artists. A quantity, if mixed dry, may be kept in a dry place indefinitely.

Mix thoroughly two parts, by measure, of asbestos paste (powder used for insulating boilers, steam pipes, etc.) and one part Portland cement. When ready to use, add just enough water to make a thick paste. The materials remain plastic for from twelve to twenty-four hours. This allows ample time to mold it into any form desired. If it is then set aside to dry slowly, it will become almost as hard as stone. It is not affected by either heat or water.

The material may be molded with the hands or worked with modeling tools into book ends, jars, boxes, bowls, plaques, and many other articles.



POPULAR SCIENCE MONTHLY SHOP DATA FILE

Square-Headed Candlesticks

TURNED IN THE LATHE

CLOCKED PROJECT

Average Time
5½ hours

BY A UNIQUE but simple method, a pair of square-headed candlesticks can be turned from one block of walnut. Mount a block about 4" thick and 4¾" square in the lathe and turn it as illustrated in Fig. 1. Leave a ring around the center 1⅞" wide and ½" deep, and undercut the sides as shown. Turn the sides, making them spherical and true, and sand them smooth.

Remove the piece from the lathe, remount as in Fig. 2, and cut off a part of the ring, as indicated, leaving a section 1⅞" square, which will later become the candle socket. Note that these sides are also undercut. Cut off the lower sides to form a spherical shape and sandpaper well.

Now remount the block in the lathe as shown in Fig. 3 and cut out a center section ⅝" wide. Removing this section cuts the candlesticks apart. Each is then fastened in turn to the faceplate so that a ⅞" tapered hole can be bored for the candle (Fig. 4).

Sand the wood to a flawless surface and apply three thin coats of shellac, rubbing them down between coats. Glue felt on the bottom.—BENJAMIN NIELSEN.

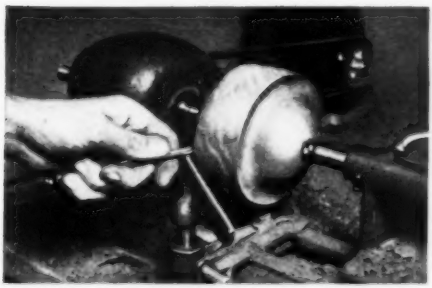


Fig. 1. Turn a ring 1⅞" wide in the center of the block, undercut it, and then round the sides

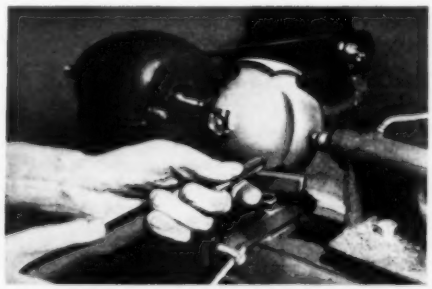


Fig. 2 Change position of turning and cut off part of the ring, leaving a section 1⅞" square

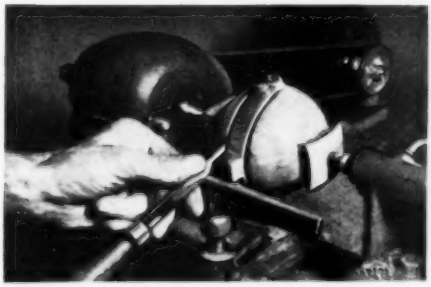


Fig. 3. Remount the block and mark center section ⅝" wide. Cut this off to give two parts

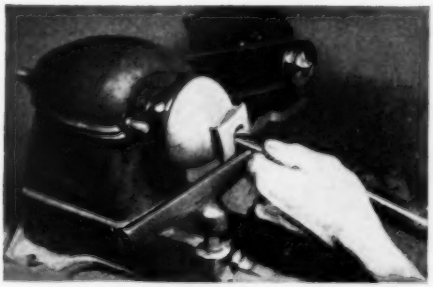


Fig. 4. Attach each holder to the faceplate so a ⅞" tapered hole can be bored for the candle

DOROTHY

Alphabet-Soup

A FAST-SELLING NOVELTY AMONG

The pins are finished with clear brushing lacquer

A small safety pin is cemented in the groove

The letters are attached with cellulose cement

A light rub on sandpaper evens up the letters

HIGH-SCHOOL students in various sections of the country have developed paying spare-time businesses by making name pins of alphabet-soup letters glued to wood bases. The cost of materials is so low that the usual selling price of a dime a pin leaves a good margin of profit.

The wooden blanks are cut from aromatic red cedar, mahogany, or other suitable wood in long strips. A good size is 3/16" thick and $\frac{1}{2}$" or $\frac{5}{8}$" wide. A shallow groove is made lengthwise along the center line of one side of each strip with a fine saw; this is to receive an ordinary small safety pin. The strips are then divided as required into the proper lengths. The cuts may be straight across, at a 45-deg. angle, or curved.

After the front surface, edges, and ends have been sanded smooth, the safety pin is fastened with quick-drying cellulose cement, a drop or two being sufficient. Place the pin so it can be opened easily.

Alphabet-soup letters, which can be purchased for ten cents or less in packages containing hundreds of pieces, are glued to the front surface of the block with the same

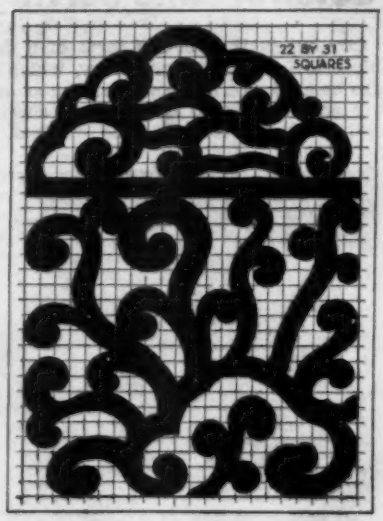
Name Pins

SCHOOLGIRLS

kind of cement. They should be applied in such a position that the safety pin can be inserted by holding it with the point to the left of the wearer. The letters may be staggered, aligned carefully, or arranged in any attractive manner to spell out names, nicknames, school initials, society names, and the like. Sharp-pointed tweezers are convenient for handling the letters; and a shallow box containing compartments, like a type case, is handy for storing the letters when sorted. After the cement has set, the letters are evened up by rubbing them on fine sandpaper, such as No. 00.

The dust caused by sanding is brushed off, any surplus cement is removed with a knife, and the front and edges of the pin are given a coat of clear brushing lacquer. This further secures the letters to the wood and, in the case of cedar, brings out the grain and darkens the color to a beautiful red. Sometimes the letters are painted, but the natural finish is generally regarded as more attractive. With reasonable care, the pins last indefinitely.—ROY ELTON.

So attractive are the pins, they sell on sight



A Pattern for Cutting Chinese Scrollwork

THOSE interested in scroll-saw work will find that an all-over Chinese pattern such as that shown above is adaptable to a great variety of projects, several of which are sketched. For use in garden furniture or outdoors, cut the panels from outdoor plywood. This type of design is also suitable for sheet-metal grilles. The pattern can be enlarged to any desired size by drawing squares and copying the outline through them.

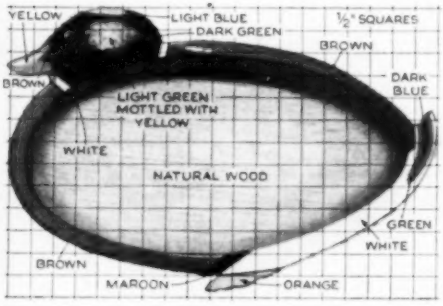
Colorful Little Serving Tray Shaped Like a Duck

CUT out in the general form of a duck, this colorful little serving tray, which can also be used as a nut bowl, may be made by any craftsman who has a scroll saw and equipment for routing. The original, designed by members of the Metropolitan Junior Achievement, New York, is shaped from a block of birch about 1⅜" by 7" by 10".

The general outline is first scroll-sawed; then the interior is routed on a drill press. The tail, head, beak, and feet are shaped with knife and sandpaper. These parts, as well as the upper edge of the tray, are painted, but first the whole may be given a protective coat of clear lacquer, if desired.

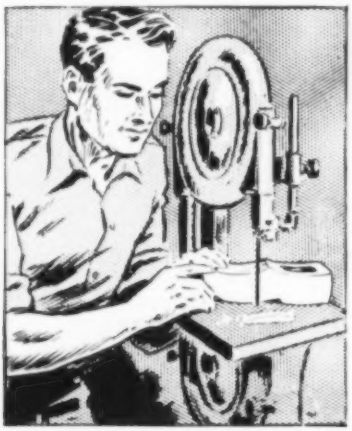
This project makes an attractive gift and also sells readily.

CLOCKED PROJECT
Average Time
4½ hours

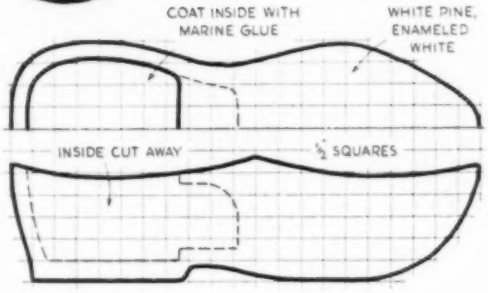


Dutch-Shoe Flowerpot Holds Two Tulip Bulbs

A BLOCK of soft white pine 3" by 5" by 8" is used for making this Dutch-shoe flowerpot for tulip bulbs. Draw the outline on the wood and remove the excess with a band saw. In the heel, hollow out a space as shown so as to provide room for two bulbs. Work the outside down with a drawknife and block plane. Sandpaper well and give the inside of the heel two or three coats of so-called "C" quality marine glue. The outside may be enameled white and trimmed with blue or some other clear, attractive color.



The shoe is shaped on the band saw and completed with a drawknife and a plane



Etched Sundial

IN BRASS OR COPPER

CLOCKED PROJECT

Average Time 6 hours

EITHER brass or copper may be used for making this sundial. It is laid out to register approximately correct time anywhere from latitude 25 to 50 deg. north, which includes all of the United States as well as part of Canada and Mexico.

Most sundials are made of brass, but for those who like an antique green finish, copper is better because, when exposed to the elements, it will take on a natural verd-green surface quicker than brass.

Lay out the dial on paper as shown. Cut out a disk of the metal to be used—14 gauge is heavy enough. Lay the pattern over the metal, place a sheet of carbon paper between, and, with a hard pencil, trace the face of the dial on the metal.

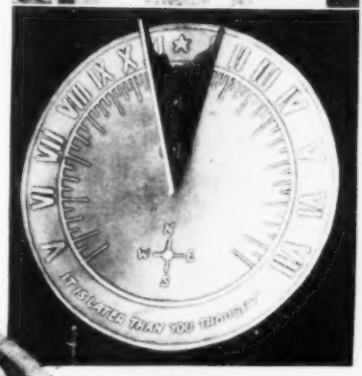
Remove the pattern, and use a fine brush to paint the numerals and lines on the metal with asphaltum varnish. Be very careful to get straight, even lines. If any lines are not perfect, finish the job and let it dry hard; then scrape away the excess asphaltum.

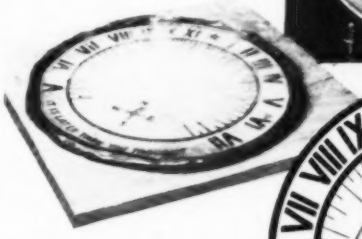
Lay the dial on a perfectly level surface and build a fence around it with putty, paraffin, or modeling clay. It must be leakproof. To about one-third teacupful of water, add *very slowly and cautiously* a like amount of commercial nitric acid. Pour this carefully over the dial, and let it etch until the acid stops working. Then add a little clear nitric acid. Continue adding acid from time to time, and rock the piece occasionally so as to insure even etching. Do not allow the acid to come in contact with hands or clothing. With the metal at a temperature of around 60 deg., the etch should reach a depth of about 0.005" in one hour.

Pour the acid out. Wash well, remove the asphaltum with kerosene or lacquer thinner, and polish the piece.

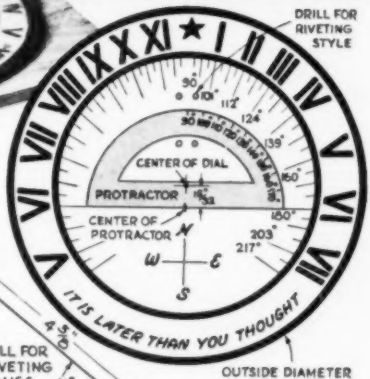
The style or gnomon for casting the shadow is cut from the same material and riveted in place as shown with brass escutcheon pins. If a polished finish is desired, coat the surface evenly with thin white shellac.—D. H.

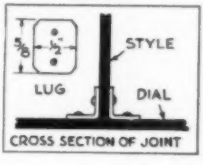
The dial is mounted on any appropriate type of pedestal





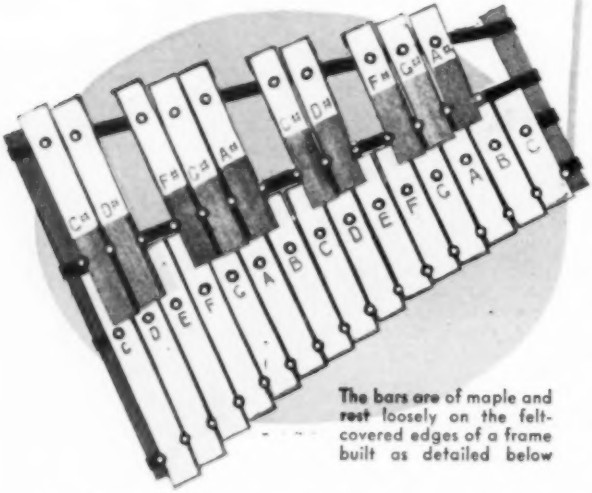
A fence of modeling clay is built around the dial and acid poured on the metal in order to etch it





TWO-OCTAVE CHROMATIC

AN EASILY PLAYED MUSICAL INSTRUMENT ANY WOODWORKER CAN BUILD



The bars are of maple and rest loosely on the felt-covered edges of a frame built as detailed below

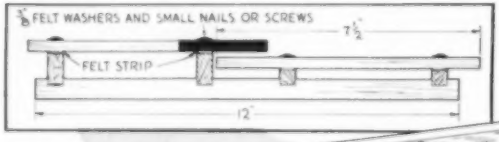
A XYLOPHONE is one of the simplest musical instruments to construct. The cost is trifling, yet the finished instrument, if accurately tuned, will be quite as good as those sold in music stores.

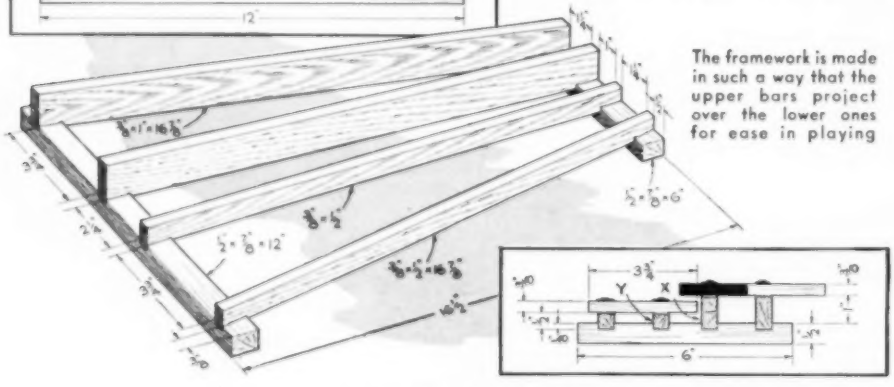
The tone of a xylophone is soft and pleasant. Even children can learn to play it without difficulty. One valuable feature is that it serves as a good introduction to the study of the piano, since the piano keyboard is laid out in exactly the same way. Provided it is tuned to standard pitch, it can be played with other instruments or with a piano accompaniment.

The frame may be of pine or whitewood. Cut the pieces to the given dimensions, place them as shown, groove the shoes $\frac{1}{8}$" deep to receive the stretchers, and fasten with glue and brads. Then block-plane the ends of the stretchers to suit the ends of the frame. Stain the frame any desired color and glue a $\frac{3}{8}$" wide strip of thin felt on the top edge of each stretcher.

Make the bars a full $\frac{3}{8}$" by $\frac{7}{8}$" to allow for smoothing. Fourteen lineal feet will be required to allow for spoiling some in tuning. They should be of thoroughly seasoned hard maple of as nearly uniform texture as possible, with the upper corners slightly rounded as indicated. Cut them in graded lengths from about 8" down to 4" or a little longer. Make about thirty of them for safety.

Place the pieces for the natural bars (C, D, E, etc.) on the frame





The framework is made in such a way that the upper bars project over the lower ones for ease in playing

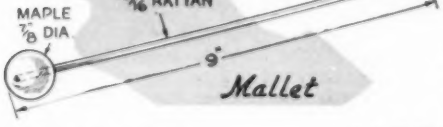
Xylophone

By CHARLES A. KING

so they just clear the 1" stretcher as at *X*. Mark the line of the center of stretcher *Y* on the bars and drill a ⅛" hole through the center of each bar. In the case of the sharp and flat bars (C sharp, D sharp, F sharp, etc.) simply drill a ⅛" hole through them 1" from the end as shown.

Place all the bars in position, center and drill a small hole in the stretchers for each bar, and drive a temporary brad through the hole in the bar into that in the stretcher to hold it.

Two mallets must now be made. The heads are turned wooden balls ¾" or ⅞" in diameter. Fit a 3/16" rattan handle 9" long into each, and glue it in place.



In tuning, strike the longest (C) bar with a mallet and compare its tone with that of C one octave above middle C on a piano. Tune the C's, E's, and G's first, then the bars between. Tune the sharp bars by the tones of the natural bars above and below them. To raise the tone of a bar, saw a little off one end of it; to lower the tone, make a shallow saw cut in the back of the bar. Avoid the latter if possible, for it deadens the tone.

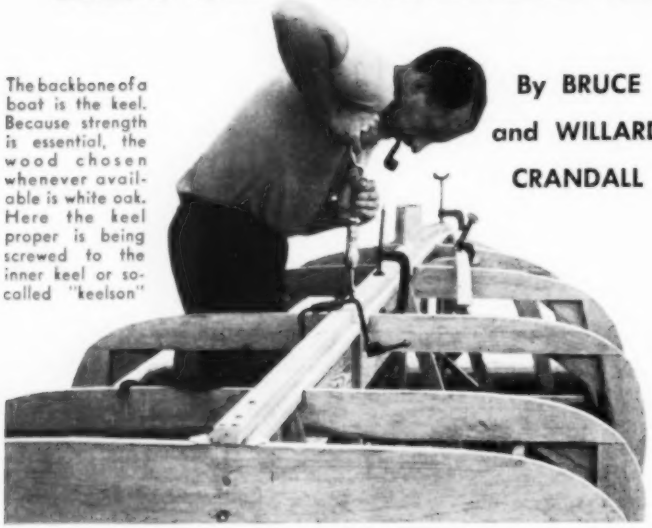
Blacken the sharp bars as shown. While these are customarily marked C sharp, D sharp, etc., it is understood, of course, that C sharp is also D flat, and so on.

Make felt washers ⅜" in diameter and drive a very thin, loosely fitting ⅞" screw or an ornamental upholstery nail to fasten each bar permanently. Be sure the bar is not held rigidly, or vibration will be restricted. The writer merely used cut-off threepenny finishing nails in making the xylophone shown in the photograph. Straighten the bars until they are all parallel; then drill small holes in the other stretchers between each pair. Drive screws or nails with felt washers under the heads to separate the bars and keep them aligned. These screws or nails also must be arranged so as not to prevent the free vibration of the bars. Place four rubber-headed nails under the corners of the frame to serve as feet.

How to Reglue Chair Joints So They Won't Come Apart

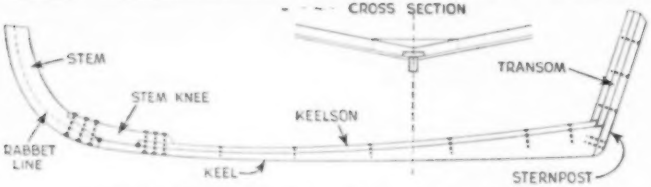
THE amateur craftsman who tries to mend a chair by driving nails through the legs into the rounds or rungs is piling up trouble for himself. Not only are the joints likely to loosen soon after the chair is placed in use, but when permanent repairs are necessary, the nails may make it impossible to take the chair apart without breaking it. Screws hold better than nails, but any method of repairing a chair short of taking it apart, cleaning off the old glue, and regluing throughout will not be efficient. This work should be done during dry weather or when the chair rounds are well shrunken by artificial heat. The rounds should also be heated before gluing, otherwise they may shrink in time and break the film of glue. When the joints fit very poorly, use metal chair-round fasteners.

Keel Construction



The backbone of a boat is the keel. Because strength is essential, the wood chosen whenever available is white oak. Here the keel proper is being screwed to the inner keel or so-called "keelson"

By BRUCE and WILLARD CRANDALL



Keel Assembly of a Small Rowboat

Another type of construction calls for a fairly deep keel. One end of the keel is spliced to the stem; the other end is fastened to the sternpost

ON MOST small boats the keel serves several purposes. It acts as a rub strip to protect the planking from damage, aids in keeping the boat on a straight course, and at the same time is usually the most important longitudinal member from the standpoint of strength.

In large boats and in all round-bottom boats, the keel is virtually the backbone; it supports the ribs, stem, and transom, and takes most of the stresses to which the boat is subjected. In many modern small V-bottom and flat-bottom boats, however, the importance of the keel is greatly reduced because the chines, battens, and planking take up most of the fore-and-aft strains.

Keels fall into two general classifications—deep keels that are sawed to shape and flat keels that are bent into position along the curve of the keel line. Because of its strength, white oak is almost always the best material to use for a keel, except in a few localities where water conditions make it impractical.

In order to prevent leaks between the keel and the bottom plank next to it, that is, the garboard plank, a rabbet is either cut the full length of the keel, connecting with the stem rabbet, or an inside keel is used to serve the same purpose. The inside keel goes by various names such as keelson, apron, keel batten, or lay board.

This keelson is screwed, bolted, or riveted to the keel and is always sufficiently wider than the keel to provide plenty of bearing surface for fastening down the garboard plank. The two-piece keel thus formed is more practical for most small boats, not only because it saves the work of cutting the rabbet, but because two pieces are much more easily bent into position than one. Except where the bottom of the boat is flat, the surface of the keelson must be beveled so that the garboard plank will fit against it perfectly. The better the two surfaces fit, the less chance there is of a leak.

The keel on a cross-planked flat-bottom boat is usually only a flat board fastened to the planking, either on the outside or inside, and its principal function is to prevent leaks by holding the planks in position. In fast boats of the hydroplane type, the outside keel is usually omitted altogether, to reduce friction.

At the bow, the stem and stem knee are usually bolted and screwed to the keel; and at the stern, the transom and transom knee are fastened in the same way. All

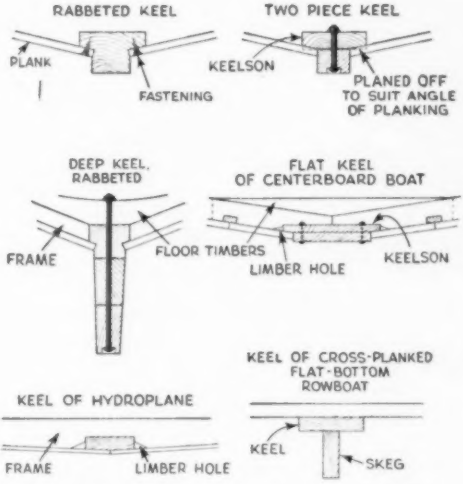
for Boat Builders

such bolts should be a driven fit, with the nuts on the inside and the heads countersunk on the outside so that they can be covered with plastic or with a wood plug soaked in paint or marine glue.

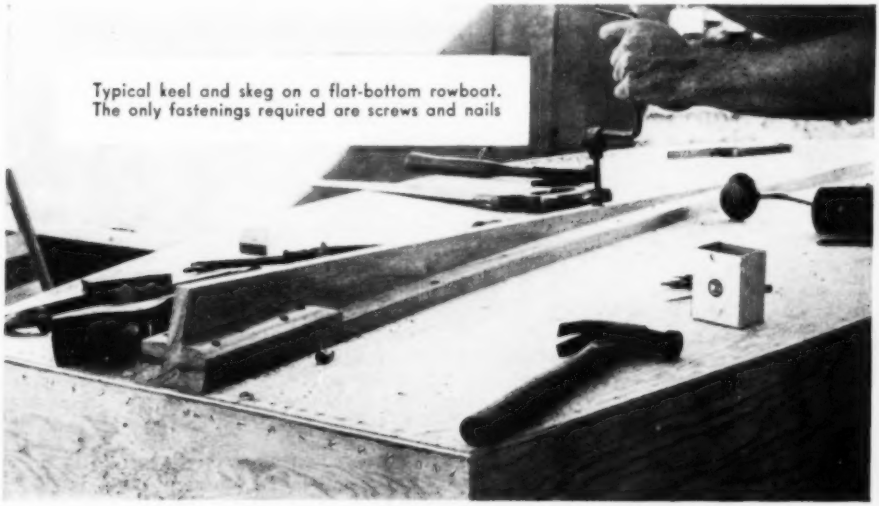
On small boats with a flat keel there may be added a skeg toward the stern. The skeg often takes the place of a deeper keel in helping to maintain a straight course while rowing. In large inboard boats a similar addition to the keel is known as "deadwood"; it protects the shaft and propeller. The skeg or deadwood is fastened to the keel proper with long bolts or galvanized rod, or in very small boats with screws only.

An upright piece at the end of the keel, skeg, or deadwood, called a sternpost, is used in many types of boats to brace the skeg, or, with an inboard, as a point of attachment for the stern bearing.

The subject of next month's article is the use of resin-bonded marine plywood, which is the greatest single contribution yet made to help amateurs build better boats. This series of articles on small-boat construction is intended to supplement the plans presented from time to time for POPULAR SCIENCE *boats. The subjects so far covered are "Stem Construction" (P.S.M., Oct. '39, p. 175); "Reading Boat Blueprints" (Nov. '39, p. 203); "Boat-Planking Hints" (Dec. '39, p. 174); "Setting Up the Frame" (Jan. '40, p. 194); and "Replanking a Flat Bottomed Rowboat" (Oct. '40, p. 183). For sails, see July '39, p. 160, and May '40, p. 176.*



Here are the chief types of keels used on small boats. Two-piece keels are well suited to amateur construction



Typical keel and skeg on a flat-bottom rowboat. The only fastenings required are screws and nails

Fishing-Rod Rack Suspended from Picture Molding

A FISHING-ROD rack of any desired size can be made at trifling expense from two pieces of scrap wood and two ordinary picture hooks of the type shown above. The rack is hung from the picture molding, and the rods are supported by inserting their tips in the slots, which must be cut to suit the diameters.—W. SCHEIDLBAUER.

Bolt Adjusts Slope of Level

TO ADJUST his spirit level for determining the slope of cement walks, one contractor uses a bolt and thumb nut. It is fastened beneath the level at any point necessary to give the required angle. In this way the forms are quickly and accurately adjusted.

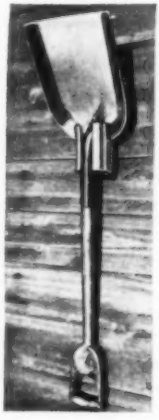
Section of Old Auto Casing Serves as Gate Latch

THIS practical latch for a farm gate may be made by cutting a notch in one side of a short section of a discarded auto casing and nailing it near the top of the gatepost as illustrated below.—G. E. H.

Method of cutting piece of tire casing and attaching it to a fence post

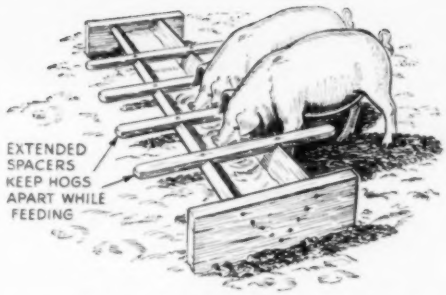
Hanger on Wall Keeps a Shovel Out of the Way

ANOTHER use for an old tire casing is as a holder for shovels and similar tools. Cut a section 6" long and with a sharp knife make a slot about 2½" long in each of the side walls. Nail this section on the wall with the slot openings facing upward. Place the blade of the shovel in the slots.—S. LONGIN.



Soldering Copper Kept Hot for Work in Cold Weather

SOLDERING outside in cold or rainy weather sometimes has to be done under conditions that make the continued heating of the soldering copper almost impossible. In such cases, heat the copper inside some nearby building to a slightly greater degree than usual and plunge it into a tin can filled with ashes, sand, or dry earth. It can then be carried to the work without losing a great deal of its heat.—ELMER E. BERGMAN.

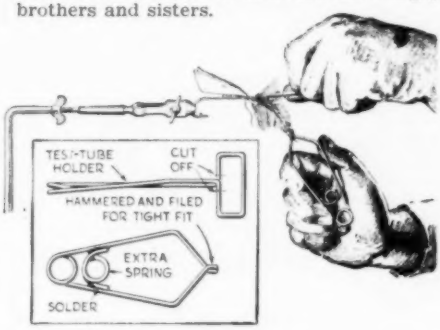


Long Bars Across Hog Trough Prevent Fighting at Meals

ENLARGING upon the idea of placing dividers in hog troughs to prevent fighting at meal times, some stockmen have gone further and extended the spacers so that each animal is confined to his own section and cannot crowd sidewise to shut out his hungry brothers and sisters.

Plants Protected from Frost by Self-Anchoring Covers

ROCKS or other weights are not needed to hold tin cans over small plants for protection from frost if the open ends of the cans are clipped to provide a serrated edge. A mere tap on top of the can will drive it into the soil. If the admission of some air to the plant is desired, do not force the teeth of the cans all the way into the ground.



Test-Tube Holder Converted into Fly-Tying Pliers

TO TIE flies expertly, it is necessary to have a good pair of hackle pliers. These can be made from a wire test-tube holder, obtainable from any chemical supply house for about ten cents. Cut off the holder where indicated; then hammer and file the ends to fit smoothly and tightly together. To increase the tension, an extra spring is then added as shown.—LEROY NOYES.

Oiled-Silk Caps for Oilstove Burners

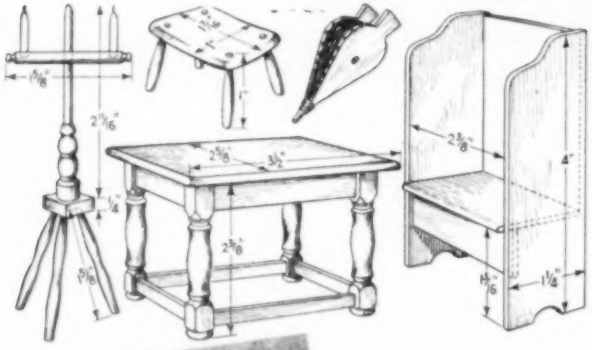
OILSTOVES, especially those used in summer kitchens, cabins, or camps, are often left unused for long periods, during which they may become very dusty. As a result, they burn poorly when first lighted, filling the room with smoke.

This difficulty can be prevented by slipping oiled-silk covers over the top of the burners when they are not being used. The covers will prevent water, dust, and food particles from falling on the kindlers, thus keeping them clean for instant use.—E. H.

Miniature

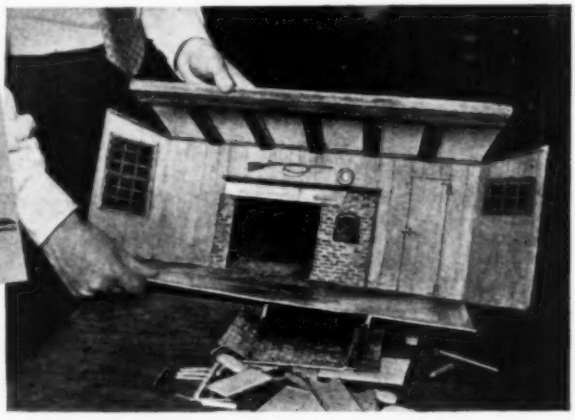
YOU'LL FIND IT EASY USING THE MATERIALS

Although simple to construct, this room is an excellent little diorama—colorful, decorative, authentic



EARLY American home life centered in the room used as both kitchen and living room. The huge fireplace served for heating as well as cooking. A long crane, mounted on one side, held several pots for general cooking, and a Dutch oven on the other side was used for baking. Frying was done with long-handled pans. The furniture was simple; a large

The assembly is begun as shown at the right. Note how the effect of perspective is obtained. Some of the small details appear above



Colonial Kitchen

TO MATCH THIS BEAUTIFUL MODEL BY IN OUR NEW DIORAMA CONSTRUCTION KIT

table, slat-back chairs, and a settle were the main pieces. The soft illumination of candle racks and wall brackets supplemented the firelight at night.

To re-create this picturesque scene in miniature takes but a few hours with a new, inexpensive construction kit POPULAR SCIENCE MONTHLY is offering to those of its readers who wish to take up the hobby of building small dioramas as outlined in the article, "Scenes in Miniature," published last month (P.S.M., Oct., '40, p. 198).

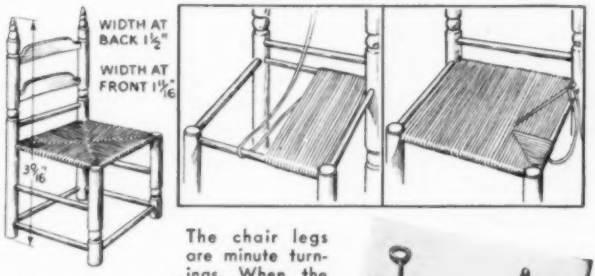
The complete kit with detailed instructions and drawings costs only two dollars. It will insure the success and artistic quality of your first attempt at this work and also teach you more about the construction of realistic and beautiful dioramas than you could hope to learn in reading many articles on the subject. The kit is illustrated on page 224. In ordering it, please use the coupon on page 226.

The room is an Early Colonial kitchen of the type most commonly in use between 1730 and 1780. A scale of 1" equals 1' was used in designing the model, which is about 21" long, 7" high, and 5" deep.

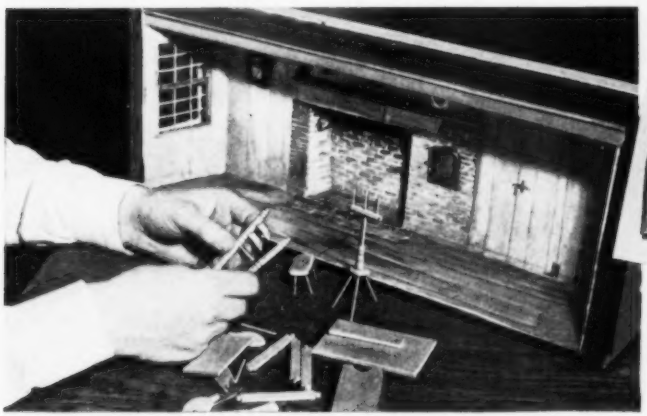
Walls, floor, ceiling, and fireplace are printed in four colors on heavy cardboard. All flat parts of the furniture have been marked on plywood and can easily be cut out. The turned parts come already shaped. Such accessories as the metal pans, andirons, and shovel are die cast and require merely to be painted.

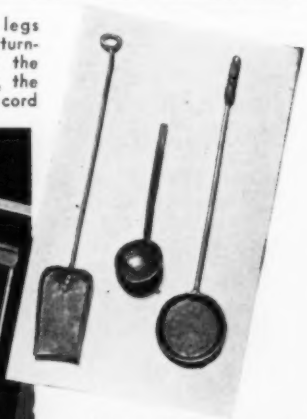
Erecting the model is a pastime the entire family can enjoy. Father and son can cut out and assemble the furniture. Mother and daughter can help install the fixtures, as well as crochet tiny rugs for the floor and make curtains for the windows.

The first step is to fold the room into

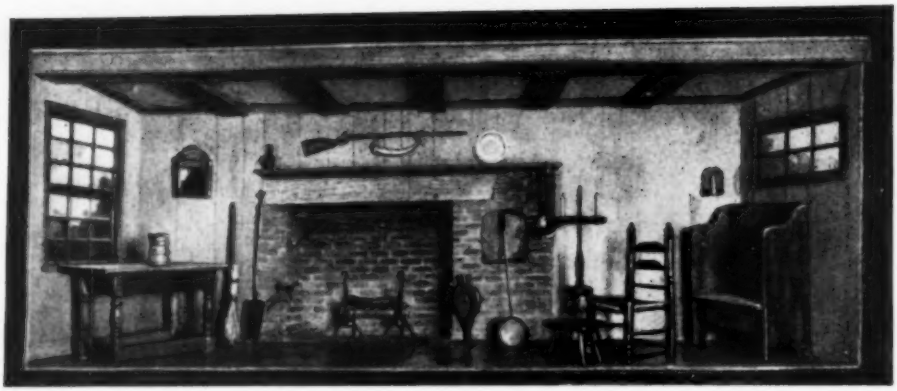


The chair legs are minute turnings. When the frame has been glued together, the "rush" seat is applied by using cord





The small metal parts require no work except painting, but the furniture pieces are scale models that have to be built up piece by piece



Constructed on a scale of 1" equals 1', the model is approximately 21" long, 7" high, and 5" deep

shape and glue the flaps where sections must be joined. Then install the front beam. A framework of wood may be added to give additional strength, if desired, but the room will remain rigid if the flaps are glued securely.

Now jig-saw the flat parts of the furniture to shape and cut the dowels to the correct lengths. Drill 3/32" holes as indicated on the drawings accompanying the kit. Sand all pieces with 3/0 paper. Rub on the wax finish and polish with a soft cloth, being careful no wax is applied to surfaces to be glued. Two applications are sufficient. Assemble the pieces with glue.

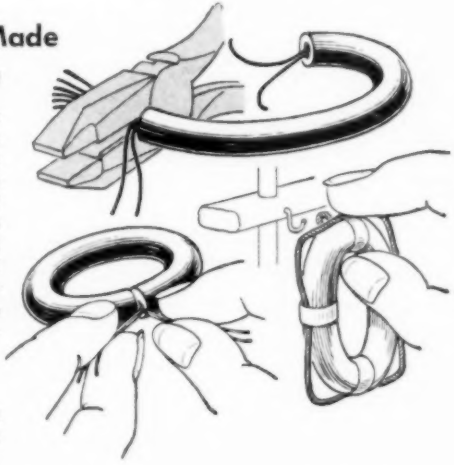
An imitation rush bottom can be given the chair by winding cord around the front and back rails, then weaving it sideways with the aid of a needle as shown. Candles are made from round toothpicks about $\frac{1}{2}$" long. Dip them in white enamel and, before it dries, place about $\frac{1}{8}$" of black thread on the top of each for a wick.

Old sandpaper forms the flexible part of the bellows. Scrape off the sand, cut a piece about $\frac{3}{4}$" by 3", and fold and glue it between the two wooden sides. Heavy black thread binds the sides and nozzle (piece of dowel) together. Coat with shellac.

Glue the chromium-plated mirror to the back of the printed cardboard frame and insert a short string through the top for hanging. Glue the transparent cellulose sheets on the outside of the windows. Fasten the rifle and powder horn above the mantelpiece with thin wire. Paint andirons, shovel, tongs, crane, kettle, and pans black. Hold the crane in position with thin wire. Glue the fireplace to the back of the room, and arrange the furniture and utensils.

Small Ship-Model Life Buoys Made from Rubber-Covered Wire

LIFE buoys for model ships may be made from flexible rubber-covered wire of the correct scale size. Bare the ends, leaving sufficient insulation between to form the buoy, and cut away all but two strands of wire at each end. Then bring the two ends around, twist the wires together, and bend into a loop. For the rope, twist several strands of écru-colored silk thread together and fasten on the buoy with narrow strips of adhesive tape. Paint the completed assembly white.—PAUL H. SMITH.



• • •

SMALL model parts can often be found at a ten-cent jewelry counter. These include chains and sometimes even good anchors.

Gas-Model Plane Parachute

INSURES CRASHPROOF LANDINGS

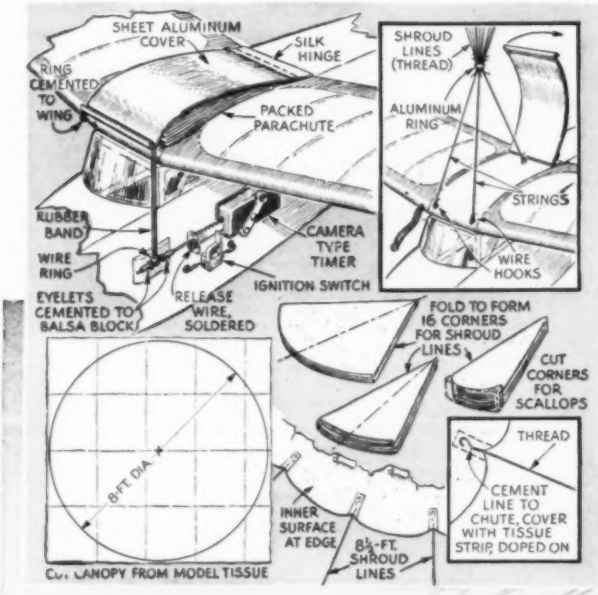
HERE is an automatic parachute attachment for lowering a gas-model plane safely to the ground. It was developed by Bob Horton, president of the Syracuse (N. Y.) Model Airplane Club.

As soon as the motor stops, a timer releases a rubber band, which in turn releases the aluminum flap under which the 'chute is packed. The wind pressure blows the flap back, and the 'chute pops out and up to unfold and bring the model down gently.

The 'chute weighs about 7 oz. and is large enough to support 3 lb. or more. It is folded for use in the same way in which it is prepared for scalloping. Have an assistant hold it up and away from the model as you fold the lines and tissue like an accordion.

A parachute is especially valuable for radio-controlled models, the high speed of which makes them difficult to land.

By FRANK ZAIC



HOW MUSIC COMES

Milk Bottles Serve as Organ Pipes

BLOWING across one end of an organ pipe sets its column of air vibrating, producing a musical tone. In long pipes the vibrations are of long wave length, and the tone is therefore low; the converse is true of short pipes. This may be demonstrated with the "milk-bottle organ" shown, for which the bottles serve as pipes and an attachment hose of a vacuum cleaner supplies a blast of air. By partially filling the bottles with water, the height of the air columns may be adjusted for pitch.

Homemade Siren Produces Musical Tone

FORCE air through a circle of small holes punched in a motor-driven tin disk. Irregularly spaced holes will give only a confused noise. Evenly spaced holes emit a musical tone, whose pitch depends on the spacing and motor speed.

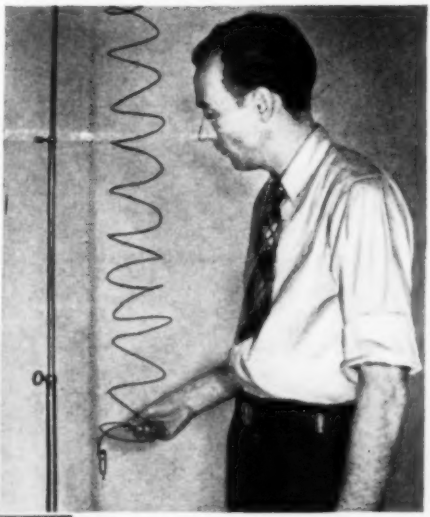
Weighted Wire Shows How String Instruments Work

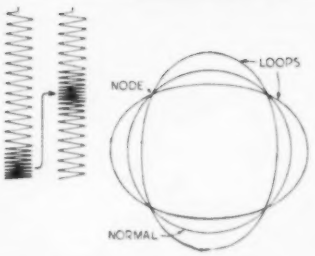
FASTEN a steel wire at one end, and weight the other, after passing it over a pulley. Its musical pitch when bowed or plucked may be raised by increasing the tension, shortening the string, or substituting a thinner wire.

FROM SOUND WAVES

Coil Spring Illustrates Sound Waves

WHAT we hear as sound is a succession of waves of compression and rarefaction, passing through the air from the source to the ear. A simple weighted spring demonstrates this mechanically. Squeeze together two or three of the lower turns, and then release the spring. A "wave of compression" will travel up and down the spring, until the original energy has all been expended. One of the small diagrams below the photograph illustrates the movement of the wave along the spring.





Easy Test for Sound-Reflecting Qualities

TO TEST the sound-absorbing or reflecting properties of various materials, place a watch in an open cardboard tube, insulated from a table with cloth or cotton. Set a cardboard sheet at a forty-five-degree angle near-by. Listen through a tube as shown. Bits of cloth laid over the cardboard will diminish the loudness.

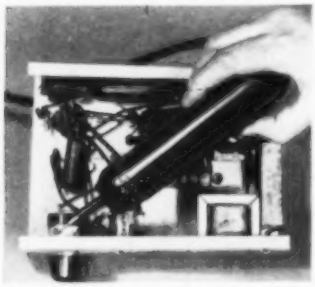
Goblet Vibrates Just Like a Ringing Bell

WHEN a bell is struck by its clapper, its rim is distorted into an elliptical shape, from which it springs back through the circular to another ellipse with its longer axis at right angles to the first. You can see this action by suspending four glass marbles in contact with the outside of a goblet, and striking the inside with a pencil.

WHAT'S NEW IN THE

Signal Tracer Quickly Locates Troubles in Receivers

CONTAINING a vacuum tube and volume control, a new signal tracer quickly locates the seat of trouble anywhere in a radio receiver. All servicing tests are said to be possible with the unit. The tester is connected to the circuit, and the set is turned on. A test prod at one end then locates the trouble when the tester causes the set to operate properly.



The tester in use. With its cover removed, left, the radio tube is visible

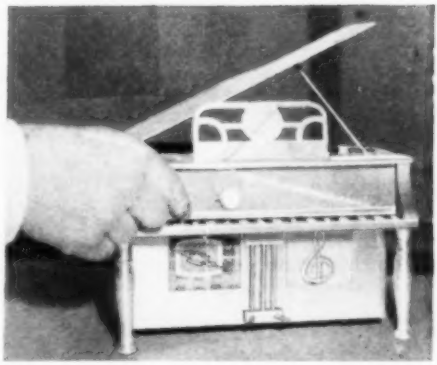
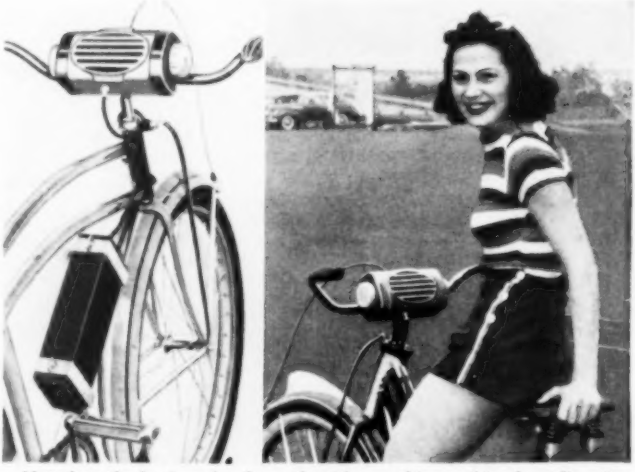


Table-Model Set Masquerades As Midget Grand Piano

AN ATTRACTIVE miniature of a grand piano recently introduced houses a midget radio receiver. As shown above, the tuning knob and switch are on the panel directly above the "keyboard," while the speaker grille and tuning dial are below. The signature of the treble clef decorates the speaker grille of the receiver.

Loudspeaker Radio for Bikes Rides on the Handlebars

WITH a new battery set designed to fit atop the handlebars, bicycle enthusiasts may now listen to their favorite programs no matter where they happen to be pedaling. As shown in the illustrations at the right, the set has convenient tuning and volume knobs at the sides, and a separate battery box that clamps to the bicycle frame. An antenna attaches to the tip of the front fender and curves back to the set. The three-tube receiver, the loudspeaker of which faces the rider, measures only 3¼" by 4¼" by 8".



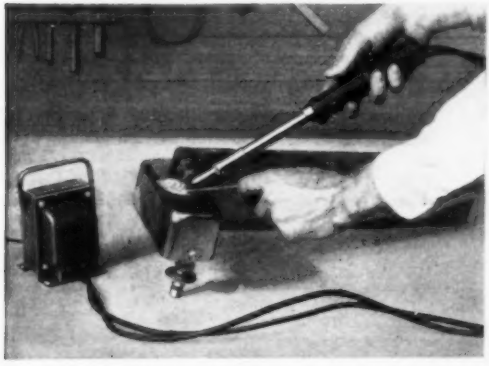
Note how the loudspeaker faces the rider on this new bicycle radio set

WORLD OF RADIO

Push-Buttons Control Wide Tonal Range

AS MANY as sixty-four tone combinations may be selected at will by manipulating push buttons on a new radio now available. By enabling the operator to emphasize both bass and treble vocal or instrumental tones simultaneously, just about any tone effect can be obtained. The tone-control push buttons are conveniently grouped at one side of the tuning dial as shown in the smaller photo above.

Buttons give the receiver sixty-four different tone settings

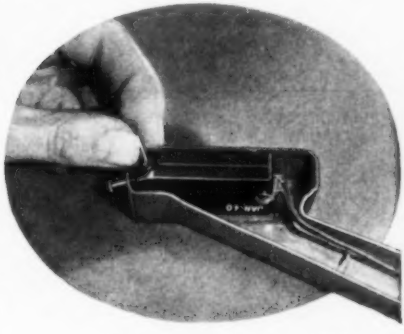


New Lightweight Soldering Iron

WIRE heating elements and heavy tips for holding the heat are eliminated in a new soldering iron for radio-set builders. The tip contains a special carbon-electrode element that is said to bring it to soldering temperature in less than a minute. Power, regulated by a convenient thumb switch, is fed through a compact transformer.

Phonograph Crystal Unit, Like Coffee, Now Dated

JUST as coffee companies, milk distributors, and others date their products to show their freshness, a maker of crystal units for electric phonograph pick-ups is now dating his products. Purchasers can thus tell at a glance just when the crystal unit was assembled.

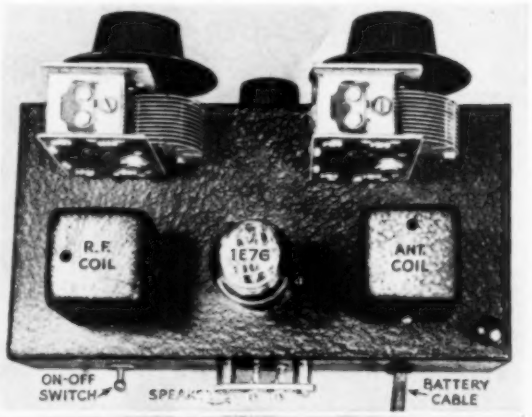


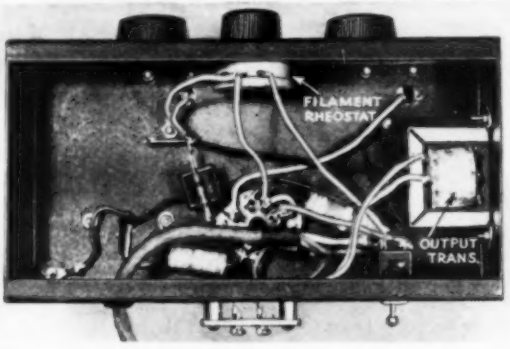
One-Tube Set Gives

WITHOUT the use of a tricky reflex circuit or hard-to-get parts this one-tube tuned-radio-frequency set will give full loudspeaker results on all local stations when a good outdoor antenna is used. Within ten miles of local stations, even an indoor antenna can be used, and its selectivity is such that powerful local stations only 30 kilocycles apart can be easily separated.

This remarkable performance is due chiefly to the fact that iron-core coils are used in the antenna and radio-frequency stages. Also, in order to get the most out of each stage, and to allow greater flexibility of control, two separate tuning condensers are used.

A double pentode power amplifier (1E7G) is the single tube used. One section serves as the radio-frequency amplifier, while the other provides the detector and output stages of the receiver. Grid-leak detection is used on the second "tube" and its plate is connected directly to the speaker without any additional audio-frequency amplification. Sufficient power is obtained with this hook-up to work a 6"





These views of the top and underside of the chassis will serve as a guide in placing the various parts. Below, the set in operation. Note the batteries and separate speaker unit

Loudspeaker Volume

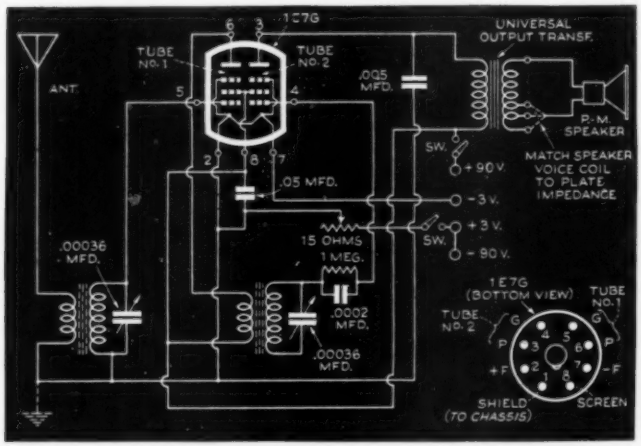
speaker without the use of any regeneration.

In wiring the set, care must be taken to connect the positive lead of the "A" battery, and not the minus, as is usually done, to the chassis. This is an important point, as the set will not operate properly if the "A" leads are reversed. A double-pole, single-throw switch serves to break both the "A" and "B" supplies and can be mounted on the rear of the chassis. The switch can be either the toggle or rotary type.

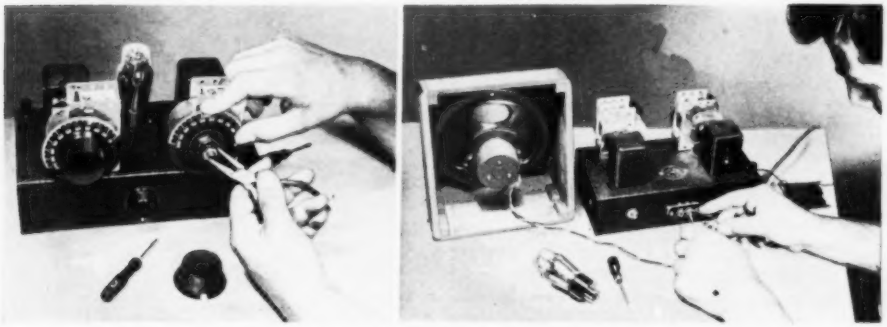
The speaker is separate from the chassis and is mounted in a "wall-type" baffle similar to those used in public-address paging systems. The baffle has a sloping front, designed to take a 6" speaker. The universal output transformer, necessary for matching the voice coil of the speaker to the load resistance of the tube (or plate impedance, as it is sometimes called), can be mounted under the receiver chassis. The load resistance of each section of the 1E7G is 16,000 ohms and an instruction sheet inclosed with each transformer will indicate the taps to use to match the speaker to that load resistance. The taps are placed on the secondary winding of the transformer.

When wiring the 15-ohm rheostat, which serves as a volume control by decreasing the filament voltage, be sure to connect the resistance winding to the 3-volt battery. Many times, the moving arm is connected internally to the shaft and if this is the case it will be grounded automatically to the chassis. In cases where the arm is insulated, it will not make any difference which way the rheostat is wired.

Since this 15-ohm variable resistance also serves to cut down the 3-volt "A" battery supply to the 2-volt maximum required by the filament of the tube, a mark should be made on the front panel just above the rheostat knob to indicate the safe 2-volt limit beyond which the



With only one tube, the circuit wiring is easy, even for a beginner



The knobs used on the original receiver have no set screws. A nut, concealed under a removable cap, holds each on its shaft. The photo at the right shows how the loudspeaker is connected

Three new-style batteries are used to power the receiver. The plug-in-type connectors save time

rheostat knob should never under any circumstances be turned.

In tuning the set, remember that both tuning condensers must be operated. The two readings will be just about the same, provided the dials are mounted on their shafts in the same relation. As a matter of fact, these two condensers can be ganged if desired, but the double control does provide greater flexibility and makes it possible to make minor adjustments in any one condenser in order that maximum volume may be obtained.

No ground is necessary with the circuit, and as pointed out earlier the type of antenna, indoor or outdoor, will depend entirely on your geographical location with respect to strong local stations.

LIST OF PARTS

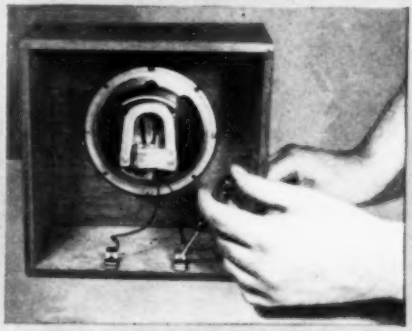
Shielded antenna coil, iron-core.
Shielded RF coil, iron-core.
Condensers, tuning, two, .00036 mfd.
Condenser, tubular, paper, .05 mfd., 600 v.
Condenser, tubular, paper, .005 mfd., 600 v.
Condenser, mica, .0002 mfd.
Resistor, carbon, 1 meg., ½ watt.
Rheostat, 15 ohms, 4 watts.
Miscellaneous: Tube (1E7G), octal wafer socket, universal output transformer, chassis (2½" by 5" by 9½"), cabinet (4½" by 7½" by 8½"), two dials, D.P.-S.T. toggle switch, two 45-volt "B" batteries, one 3-volt "A" battery, PM speaker, wire, solder, etc.

Get Started IN Radio

BY ADDING a half-dozen parts to the all-electric receiver described last month as part of this series, you can provide a final stage of amplification. For this stage, the power pentode in the 70L7GT tube is used, and with this additional power there will be sufficient volume to operate a loudspeaker. The speaker, included in the original list of parts (P.S.M., Sept. '40, p. 196), is a 5" magnetic unit which can be mounted in a small homemade wooden cabinet. If you do not wish to go to the trouble of making up a special cabinet, the speaker can be mounted on a small baffle about a foot square. Two Fahnestock clips can be used to connect the speaker to the set. These are mounted just inside the cabi-

ADDITIONAL PARTS

Mica condenser, .002 mfd.
Electrolytic condenser, 10 mfd.
Fixed resistor, 150,000 ohm.
Fixed resistor, 1 megohm.
Fixed resistor, 600 ohm.
Loudspeaker.



Two spring clips serve as speaker connectors

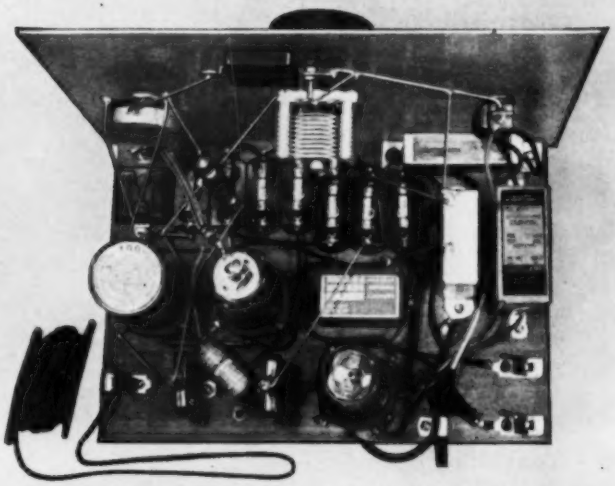
PART III . . . A FOUR-TUBE RECEIVER

net, along the bottom (see photo).

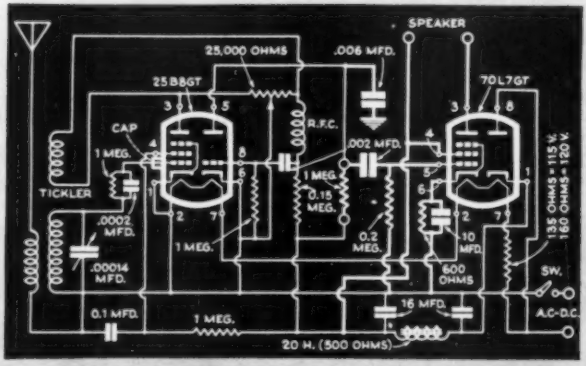
The additional parts required from the original parts list are: one .002-mfd. mica condenser, one 10-mfd. electrolytic condenser, and three fixed resistors (150,000 ohm, 1 megohm, and 600 ohm).

When making the various changes, note that some fixed resistors used originally have been juggled around a bit. For instance, the 200,000-ohm resistor used in the plate circuit of the three-tube circuit has been replaced by a 150,000-ohm resistor and the 200,000-ohm resistor used in the grid circuit of the power pentode (70L7GT). The original .006-mfd. paper tubular condenser is used this time as a bypass condenser between the plate of the triode (25B8GT) and the ground (or chassis). No ground connection is needed with this "four-tube" circuit.

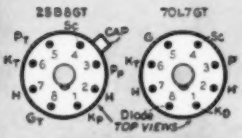
Any type of antenna may be used.



The circuit as it appears wired as a "four-tube" receiver. The antenna wire is coiled at the left. The clips at the right are for the speaker



In wiring the circuit be sure to follow the diagram carefully. The new portion of the circuit is indicated by the heavy lines. Socket connections are shown below

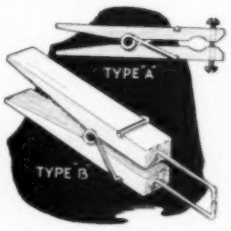


When it is not in use, the stamp pad is kept closed by turning a screw eye

Stamp Pad Nailed on Wall Above Shipping Bench

A SHIPPING clerk keeps his stamp pad handy and prevents others from borrowing it by tacking it on the wall above his workbench as shown. A screw eye serves as a turn button to hold the box closed.

Spring Clothespins Changed into Soldering Clamps



SPRING clamps for holding small metal parts that are to be soldered or brazed can be made from ordinary wooden clothespins. For the type shown at *A*, clamp a clothespin in a vise so that the jaws will remain in line and drill a hole slightly smaller than the roundhead screws to be used. After the screws have been inserted, pass a thin file between the points to flatten them.

Clamp *B* is used where very small pieces are to be held for soldering. It consists of two pieces of wood shaped as shown to take the spring from a spring clothespin. The metal jaws are two nails. One is flattened on the end, and the other is left pointed.—J.A.A.

• • •

TO IMITATE frosting on glass, mix 6 oz. epsom salts in 20 oz. warm water and add 2 oz. white dextrine; then apply to the glass.

Copper Strip Improves Soldering Iron

SOME electric soldering irons have heating elements considerably smaller than the casing. An iron of this type will heat more rapidly and be more efficient if a strip of sheet copper is wedged between the element and the casing so as to bring them into firm contact.—G. S. G.

REPLACING CANE WEBBING IN CHAIR [*SHIPSHAPE HOME*]

With hammer and chisel, remove spline holding old cane in place. Clean out groove thoroughly with chisel, but be careful not to chip wood.

Prepare four or five wooden wedges tapering from ¼″ to ⅛″ in thickness and about 1″ wide. Select spline that fits loosely in groove and cut to correct length with a lap of at least ¼″, which can be trimmed later. Soak woven cane webbing in water from one-half to one hour until pliable, then lay on seat and trim to exact shape, allowing ½″ additional around the entire piece. Make certain front of seat is parallel with strands of webbing.

Drive webbing into groove and hold with wedges, first at back, then in front, and finally at sides. Trim off excess webbing with chisel around outer edge in bottom of groove. Pour glue (preferably hot cabinetmaker's glue) into groove and insert spline. If spline is stiff, first steam it or soak in hot water until pliable. Drive spline into place with rawhide mallet, or use soft wood to protect it from being marred. Remove excess glue with wet cloth and let glue set for at least 24 hours.

If seat is not tight after drying, wet the underside with water and place in sun or near radiator or furnace.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

OUTDOORS IN SUNLIGHT

INDOORS AT NIGHT

...either one is a winner!

TONIGHT make a picture-taking date with the whole family. And for surer results in your snapshots at night, under Photofloods, load with Kodak Super-XX Film . . . about four times as fast as ordinary film. You can then, from the very first, count on indoor snapshots at night that are as clear and brilliant as those you have been getting outdoors in the sun.

And your camera doesn't have to be an expensive one, either. Any camera that takes Kodak Super-XX Film will do, even a $1 Baby Brownie.

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KODAK SUPER-XX FILM

A... Load your present camera with Kodak Super-XX Film

B... Use a couple of inexpensive Mazda Photoflood lamps in Kodak Handy Reflectors

C... Follow the few simple directions in the FREE Booklet

A few minutes with this helpful booklet and you're headed for splendid nighttime snapshots. Photos, diagrams, easy-to-understand directions. At your dealer's ... Eastman Kodak Company, Rochester, N. Y.

Have you heard about these

New Willard Products?

WILLARD ANTI-FREEZE
IT'S ODORLESS!

Highly effective—three quarts are equivalent to approximately four quarts of ordinary alcohol. Contains a special anti-rust ingredient that protects the cooling system.

WILLARD DRY CELLS AND FLASH-LIGHTS

Built to the same rigid specifications for which Willard is famous. Try the new sturdy, streamlined Willard Flash-lights and the new Willard Dry Batteries built to last longer!

HINTS ON BATTERY CARE

It's not the cold weather that ruins batteries

Winter starting failures are often the result of injuries your battery received during hot weather. Heat speeds up the chemical action of your battery—causes the water to evaporate more rapidly—increases the danger of buckled plates and charred insulators. Let your Willard Dealer make sure that the "wear and tear" of summer driving hasn't harmed your battery—see him NOW.

SEE OPPOSITE PAGE . . .

Willard

YOUR ASSURANCE OF QUALITY

Rubber hose tacked to the ends of a board will hold it in place as a deflector

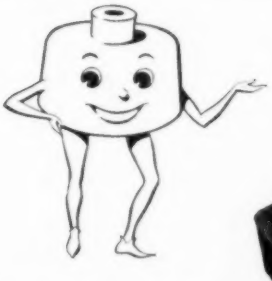
Draft Deflector Is Wedged Between Window Jambs

WHEN a board is used to deflect the direct draft from a partly opened window, you can fasten it securely in place and also remove it without the least difficulty by tacking a length of rubber hose to each end as shown. The shield will then wedge firmly between the window jambs on each side and stay at any desired angle.

Old Fountain Pen Contains Handy Razor-Blade Knife

FROM an old fountain pen and a razor blade, I improvised a knife that could be carried safely in a pocket and used for cutting clippings. Discard the pen point. Split a 1" length of lead pencil lengthwise and remove the lead. Place a narrow razor blade between the two halves and bind with sufficient cellulose tape to insure a tight fit in the hole from which the pen point was removed. About 1" of blade projects.—M. K.

"Have you heard about the New SAFETY-FILL Willards ?"



"WHEN YOU PUT THIS CAP ON THE 'SAFETY-FILL' VENT YOU SEAL AN AIR POCKET – THAT KEEPS WATER FROM RISING BEYOND CORRECT LEVEL – PREVENTS OVERFILLING"
Safety Phil
SAFETY-FILL

LONGER LIFE

10-15% more miles and months

These *new* Willards are the finest batteries we have ever built! They give you 10 to 15% longer average life . . . even longer than former Willards . . . at *no* extra cost.

MORE RESERVE POWER

Active materials increased 7-9%

All of these new Willards are built with either thicker plates, bigger plates or more plates. Result —you get longer life plus plenty of *reserve* power for lights, radio, heater, other accessories—and winter starting.

GUARANTEED CAPACITIES

You know what you're getting

Every Willard has its *guaranteed* ampere-hour capacity *molded* in the case. You can see *exactly* what you're getting. And you pay *only* for what you get. Look for this guarantee of *full measure* of battery value.

PLUS— "Safety-Fill"

Stops dangerous corrosion

"Safety-Fill" is an exclusive Willard device that prevents overfilling—guards against acid spray on wiring and motor parts. It protects your car against corroded cables and terminals that cause current losses and unexpected starting failures.

★ ★ ★

Your Willard dealer has a fresh stock of these "More-for-your-Money" batteries now. Look for his red-and-white Willard sign or the name "Willard" in the classified section of your phone book under "Batteries."

WILLARD STORAGE BATTERY CO.
Cleveland • Dallas • Los Angeles • Toronto

Willard

SAFETY-FILL BATTERIES

STOP DANGEROUS CORROSION

MORE BATTERY FOR YOUR MONEY!

SOME SMOKERS THINK IT'S

FIERCE!

Others *know* there's no tobacco on earth that equals this truly AROMATIC pipe mixture

Some people don't like anything *new*. Here's such a new, *different* smoking-experience that some men don't like it. But thousands won't touch any tobacco but Bond Street.

Bond Street's like expensive custom-blends in flavor, fragrance, bite-free coolness. Contains *rare aromatic tobacco never before used in a popular price mixture.* Even women approve its aroma.

In fairness to yourself, get a 15¢ tin — today!

15¢

Today—try a tin of

BOND STREET

Pipe Tobacco

A Product of **PHILIP MORRIS**

Old Bill *says*

A STEEL plate with a substantial layout of tapped holes is a convenience when bolted to the table of a drill press. The holes save time in clamping work.

• • •

It takes a good torch mechanic to cut carbon or high speed steel without scorching, but it takes nothing short of an expert to hold a perpendicular cut in stock over 4" thick.

• • •

Rather than take the time to bore a hole accurately in stock held in a three-jaw chuck so as to remove 0.002" from a 2" hole in a hardened sleeve having only a 0.072" wall, I soldered the part lightly to a V-cut angle plate and trued the assembly concentrically on the lathe faceplate.

• • •

Bores in A-1 die castings are usually to size, but if they are slightly undersize, a hardened and relatively ground burnishing bar pressed through will produce the required size and give a high finish to the bore.

• • •

If you can't afford regular contour sawing equipment, metal band saws are so reasonably priced that you can save the slug without tedious drilling and chipping to derive an internal outline. Drill holes to clear all corners, cut the saw, pass one end through a hole, weld the saw, and go to work.

• • •

Judging from my own observation, I believe that a man with average intelligence can learn more in a week, if he stands by a highly experienced machine hand and asks questions, than he will in four at one of the training sessions now popping up everywhere.

• • •

When it is necessary to spot-grind the face of a part with a saucer-shaped wheel, the finish will be absolutely square only if the network of the minute lines is crisscrossed.

• • •

Because of its delicate cutting edges, a broach gets hurt just as much on the return stroke as it does on the cutting stroke. For this reason the alignment can never be too perfect.

New Scroll Saw of 1,000 SPEEDS

Any Speed From 650 to 1700 R. P. M. at a turn of your fingers

The Most Remarkable Scroll Saw Ever Made

Now, for the first time, you can have a Scroll Saw that, at a turn of your finger, gives you the exact speed that best fits the material you are sawing—high speed for fast, fine work—low speed for heavy work—and ANY speed in between! In addition the new Delta Multi-Speed Scroll Saw gives 24″ throat capacity—Timken Bearing crankshaft, shaft driven blower pump which makes air available even for sabre-cutting—universal tilting table for bevel cutting as well as for straight cuts—a completely universal blade guide—high speed ' lade support—adjustable blade tension—splash-lubricated drive—tilting spring hold down—and many other features that have caused experts to call it "The Finest Scroll Saw Ever Made." For full description, specifications and low prices, fill out the coupon below.

Inside Secrets of Delta Quality

"PRECISION GRINDING"

All arbors, spindles, bearing seats, etc. on Delta machines where accuracy to close limits is important, are ground to size. Turning to size is "good enough" for many manufacturers but not for Delta machines! Precision grinding to size, after turning, is an extra operation. It costs more money—and you can't see it as you can see nickel plating on the outside of the machine. But in a bearing or bearing seats, it provides a fit that is "all over" instead of only on a comparatively few high spots. This means that ball bearings do not become loose in service. Precision grinding produces a *closer* fit, to more exacting tolerances, which means that fits are uniformly good, and that true interchangeability is obtained.

The extra accuracy obtained by precision grinding may be visualized when it is realized that the *ordinary* variation or tolerance on Delta arbors and spindles is three ten-thousandths of an inch, and in many instances this tolerance is held to one ten-thousandth.

Before you buy any light machine tool, make sure all parts that vitally affect the accuracy and life of your machine, are *precision ground* to size!

Send for Latest Delta Catalog

A complete guide book to power tools which not only lists the complete line of Delta "Quality" wood and metal working tools—but shows you the important points to look for in all power tools. It illustrates and explains the advantages of the many hidden features of design and construction that make for long, better service in power tools. (Also send for Project Book No. 7 crowded with new projects, including working drawings, photographs and full instructions.)

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Delta Manufacturing Company
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Milwaukee, Wis.

Gentlemen: Send me the latest Delta Catalog listing the complete line of Delta Lathes, Circular Saws, Band Saws, Jointers, Scroll Saws, Shapers, Sanders and Drill Presses.
☐ I enclose 10c (stamps or coin) for which please send me the new Delta Project Book No. 7.

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Address .....
City ..... *State* .....
☐ Check here if you are a Delta user now. (B1140)

SHORT CUTS FOR THE HOME CRAFTSMAN

How to polish metal with cloth!

● The cloth is Aloxite Brand Aluminum Oxide Cloth. It is excellent for producing a polished surface on metal objects and for removing small amounts of metal in fitting parts. For a flat surface the cloth is laid on a flat table, as illustrated, and the work rubbed over it.

In addition to all kinds of polishing operations on metal, Aloxite Brand Cloth can be used for the removal of rust or for cleaning prior to soldering. It is available for an endless number of uses in sheet or roll form.

Ask your hardware dealer or mill supply house to show you the complete line of Carborundum-made coated abrasives, sharpening stones, grinding wheels and other abrasive products for the home craftsman. Send 10¢, coin or stamps, for souvenir sharpening stone and valuable illustrated manual on how abrasive products can save time and help you do better work.

CARBORUNDUM ABRASIVE PRODUCTS

Dept. S 110

THE CARBORUNDUM COMPANY
REG. U. S. PAT. OFF.
Niagara Falls, N. Y.

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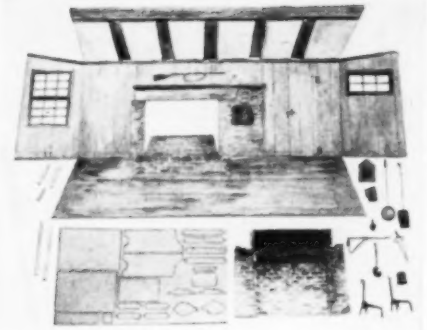

Colonial-Kitchen Model Added to Our CONSTRUCTION KITS

FUN for the whole family is contained in the construction kit pictured above. With it can be built a miniature Colonial kitchen approximately 21" long, 7" high, and 5" deep (see p. 206). Accurate in every detail, the model is an attractive example of truly American architectural design. Father, mother, son, and daughter can share the pleasure of putting it together and furnishing it, although the work can easily be done by one person if desired.

The kit costs only $2.00 and consists of all the following: walls, floor, ceiling, and fireplace printed in four colors on heavy cardboard, which must be folded into shape; turned legs for table, chair, and candle rack; other wood parts stamped on thin plywood ready to be jig-sawed apart; dowels for chair rungs and stool legs; die-cast metal andirons, tongs, cooking crane, bottle, mug, candle bracket, two pans, shovel, and mirror light; kettle; two windows; jar of wax; and packages of pins and glue.

Construction kits for building a wide variety of ship models, three whittling kits, and a marionette kit are also available. The complete list follows:

MODEL-OF-THE-MONTH KITS

M.	Aircraft carrier SARATOGA, 18" long	$1.00
N.	Convoy of four U.S. destroyers, for aircraft carrier, each 6¼" long	.75
R.	U.S. cruiser TUSCALOOSA, 11¾" long	1.00
U.	HISPANIOLA of the book and movie "Treasure Island," 7" long	.50
Z.	H.M.S. BOUNTY, 8½" hull, 11½" over all	1.50
2M.	Ocean freighter, 14" long	1.50
3M.	Yacht NOURMAHAL, 8⅛" long	1.00
5M.	Liner PRESIDENT LINCOLN, 14¾" long	1.50
6M.	Fishing Schooner WE'RE HERE of "Captains Courageous," 9½" over all	.75

(Continued on page 226)

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Iron Glue holds tight, is extra strong. You can buy it 'most anywhere—¼ pt. to 1 gal. cans or 10c bottles. **FREE:** Send post card for booklet, "Better Results with Glue," to: McCormack Sales Co., 404 Light St., Baltimore, Md.

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AN ELEPHANT FOR STRENGTH

50¢ REFILLABLE KNIFE

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◆ Sand Casting—Forging—Heat Treating — Case Hardening

Make your own castings of aluminum, copper, bronze, silver. Foundry sets are available in three sizes including 2400 Deg. F. blast Furnaces, $13.50, $19.00, $27.50, f.o.b. Kansas City. Free Circular.

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CAN BE USED OVER AND OVER. FIRST TRACE PATTERN WITH PENCIL, THEN FILL IN WITH BRUSH. SPECIAL TRIAL OFFER: YOUR CHOICE OF 1¾", 2" OR 3" ALPHABET (26 LETTERS, 10 NUMBERS) WITH LETTERING BRUSH, $1.00 POSTPAID. SALE SIZE & STYLE WANTED, WRITE FOR FOLDER.

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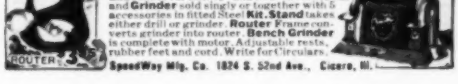

Quality Tools—products of SpeedWay, for 30 years leading manufacturers of electric tools. Specially wound high torque 110V universal tool motors. Improved designs; correct speeds. 1000 RPM **Drill** with die cast handle has ¼" capacity in steel. 20,000 RPM **Hand Grinder** has speed essential for efficiency and collets for both ⅛" and 3/32" arbors. **Drill and Grinder** sold singly or together with 5 accessories in fitted Steel **Kit. Stand** takes either drill or grinder. **Router** Frame converts grinder into router. **Bench Grinder** is complete with motor. Adjustable rests; rubber feet and cord. Write for Circulars.

SpeedWay Mfg. Co. 1824 S. 52nd Ave., Cicero, Ill.

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Lowest priced Jointer in U.S.A.

Oh, man, what buys these are!

Every one a solidly built, practical tool. Most any small electric motor supplies sufficient power. Marvelous Xmas gifts. So inexpensive you can afford several. Sold direct-by-mail only.

GREAT NEW JOINTER Only $6.50

—and a beauty! Planes, cuts angles, etc. Weighs 8 lbs.; measures 4½" x 8½" x 10¼". Table 4¾" wide with two 4" tempered cutter steel knives in safety-type cylinder with automatic guard.

Drill Press: 13" high, drill table 3" in diam.; drilling to center of 4" circle. Table fully adjustable. Ball thrust bearing for long wear. The slickest card for quick, accurate drilling.

DRILL PRESS $2.50

$1.50 JIG SAW

$1.50 PRIZE CONTEST

Jig Saw: Includes 12 assorted blades, blade adapters, roller saw guide and manual. 12" long, 8" high, 6½" table. Cuts wood up to 2" thick.

Circular Saw: 4" combination rip and crosscut blade. **Oilless bearings.** 8" x 5¾" steel table adjustable so that by turning steel pieces up to 2" thick may be cut. Adjustable ripping fence. Saves hours of hand sawing.

CIRC. SAW $3

New! 24" WOOD LATHE $4.90

A husky, smooth running wood lathe 32" long overall; 7" high; weighs 10 lbs.; fully adjustable; oilless bushings; long and short tool rests; two speed pulley.

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Guarantee: Satisfaction or full refund if goods returned within 5 days.

FREE CATALOG describing $150 prize contest. 1st prize $25; 2nd, $15; 3rd, $10; 41 other cash and merchandise prizes. Cat. illustr. complete power tool line. Outside U. S. A., all tools 25c extra except Jointer and Lathe, 50c extra. Orders shipped C.O.D. 25c extra per package. Postal laws permit no C.O.D's outside U.S.A.

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Save 2c . . . stick coupon on penny post card.

List of Construction Kits

(Continued from page 224)

7M. Fleet of nine modern U.S. fighting ships, including superdreadnought, light cruiser, aircraft carrier, submarine, and five destroyers; scale, 1" equals 100'..... 1.50†

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. MANHATTAN, 12" long..... 1.00
H. Cruiser U.S.S. INDIANAPOLIS, 12" long... 1.50
J. Clipper SEA WITCH, 9½" hull, 13" over all 1.50

STANDARD SHIP MODEL KITS

A. Whaling ship WANDERER, 20½" hull, 27" over all..... 7.40*
D. Spanish galleon, 21" hull, 30" over all..... 6.95*
E. Battleship U.S.S. TEXAS, 3' long..... 7.45*
G. Elizabethan galleon REVENGE, 25" hull, 28" over all..... 7.25*
L. Farragut's flagship HARTFORD, steam-and-sail sloop-of-war, 33½" hull, 41" over all..... 8.45*
Q. Privateer SWALLOW, a Baltimore clipper, 12½" hull, 20" over all..... 4.95†
V. Clipper SOVEREIGN OF THE SEAS, 20½" hull, 26" over all..... 4.95†
Y. Trading schooner, Maine type; 17½" hull, 22½" over all..... 4.90†
2S. U.S. Navy destroyer PRESTON, 31½" long 5.95*
3S. CONSTITUTION ("Old Ironsides") 21" hull, 31" over all..... 6.50*
4S. Clipper ship GREAT REPUBLIC, 31½" hull, 42" over all..... 8.40*
5S. Coast Guard Patrol of 165-ft. type, 20⅝" long..... 4.95*
6S. Brig MALEK ADHEL, 20" hull, 33" over all; frame-and-plank construction..... 9.75†
8S. Fishing schooner BLUENOSE, 17½" hull, 22" over all..... 4.95†
9S. New Bedford whaleboat, with complete equipment, 14" long..... 2.75†
10S. Confederate raider ALABAMA; steam sloop, bark rigged; 21½" hull, 28" over all..... 8.20*
11S. Revenue Marine Cutter JOE LANE, a top-sail schooner, 13½" hull, 21" over all (Kit contains precision-shaped hull and finished blocks, deadeyes, belaying pins, etc.)..... 7.00†

MISCELLANEOUS

7. Whittling kit with two shaped blocks for making sea captain 5½" high..... 1.50
8. Whittling kit for six different Scotties; each is 2" by 2⅛", sawed to shape..... 1.00
10. Copycraft whittling kit for making one of several Hobo Hank novelties. Includes master model 5¾" high..... 1.50
12. Marionette kit for making a model of Dopey the Dwarf, 9" high. Ready to assemble..... 2.25†
13. Miniature Early Colonial kitchen 21" long, 7" high, and 5" deep, with materials for furniture and finished fittings..... 2.00

Note: If you live west of the Mississippi River or in Canada, add 50 cents to prices marked with an asterisk (*) and 25 cents to prices marked with a dagger (†).

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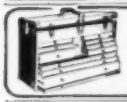

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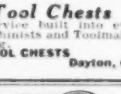

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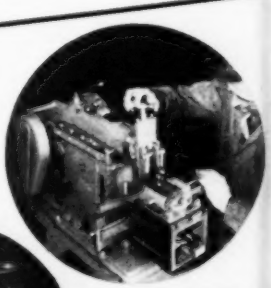

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for workshop and home

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150-watt G-E MAZDA Reflector lamp **95¢**

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GENERAL ELECTRIC

Early Colonial pine chest, plan 308A, 25c

Tested Shop Plans for Making Gifts

CHRISTMAS is less than three months away, so now is the time to start planning those gifts you intend to make for your family and friends. To assist you, POPULAR SCIENCE MONTHLY offers a wide variety of blueprints for constructing models, furniture, boats, toys, radios, and novelties. A few of the projects are listed below. A complete list will be sent free upon receipt of a self-addressed, stamped envelope.

MODELS

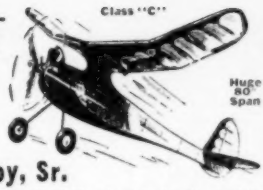
Brig MALEK ADHEL, 20" hull, frame-and-plank or solid-hull construction, 304-305-306-R $1.25
Clipper Ship in a Bottle, 121-122 ..... .50
Clipper Ship SOVEREIGN OF THE SEAS, 20½" hull, 51-52-53-R 1.00
Cody Coach, 13" long, 144-145-146-R 1.00
CONSTITUTION ("Old Ironsides"), 21" hull, 57-58-59-R 1.00
Cruiser U.S.S. INDIANAPOLIS, 12" long, 216 ..... .25
New Bedford Whaleboat, with complete equipment, 14" long, 326-R ..... .50
Privateer SWALLOW, a Baltimore Clipper, 13" hull, 228-229-230-R 1.00
Racing Yacht, 20" Marconi-rigged sailing model, 48-R ..... .50
Spanish Treasure Galleon, 24" long, 46-47 ..... .50
Trading Schooner, 17½" hull, 252-253 ..... .50
U. S. Battleship TEXAS, 3' hull, 197-198-199-200 .. 1.00

BOATS

Cabin Cruiser, 17' long, weighs 750 lb., for use with outboard or inboard drive, 356-357-358-359-R 1.50
Folding Duck Boat, 13' long, 170-R .... .50
Fisherman's Outboard Boat, 9' 3" or 11' 6" long, weighs 115 or 160 lb., for motors from 3 to 16 h.p., can also be rowed, 344-345-R ..... .75
High-Speed Boat for Small Outboard Motors, 7' 11" long, 257-R ..... .50
Motorboat-Rowboat, 13' long, with decked hull, for use with outboard or inboard drives, 147-R .50
Plywood Dinghy, 9' 7" long, weighs 60 to 75 lb.; can be rowed, sailed, or used with small outboard motor, 387-388-R ..... .75
Racing Sailboat BLACKCAT, 13' 4" long, weighs 250 lb., Marconi rigged, 321-322-323-R 1.00
Sectional Rowboat, 9' 8" long; can be used with small outboard, 340-341-R ..... .75
Sport Runabout, 9' 8" long, for small outboard motor, weighs 100 lb., 309-310-R ..... .75
Utility Rowboat, 13' long; can also be sailed or driven by outboard motor, 224-R ..... .50

(Continued on page 230)

Build the Gas Model that "Broke the World's Record Twice in One Week"



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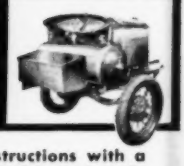

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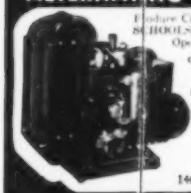

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Tested Workshop Plans

(Continued from page 228)

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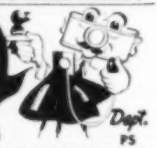

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Mounting Prints to Enter in a Photo Exhibition

ANY print you expect to enter in a photographic exhibition should be mounted to conform with certain well-established requirements. Even if you have no intention of sending prints to camera shows, there are advantages in following exhibition specifications in mounting your better enlargements to form a uniform collection.

The mount must be of light-colored or white stock. The choice of mounting board, which comes in several different surfaces and tints, depends on the type of wall it is to be hung on.

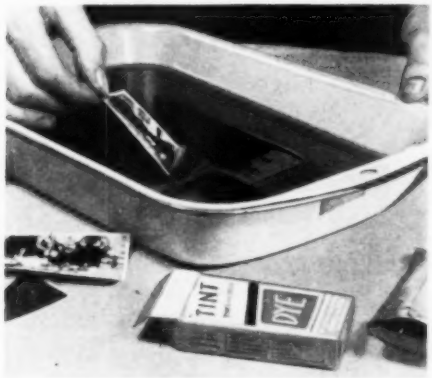
Definite rules are followed in exhibiting prints this way. Although a few salons will accept various other sizes, 16" by 20" is fast becoming the standard mount. Some salons, due no doubt to the available hanging space and necessity for uniformity, require that all prints be mounted to permit mounts to be hung *(Continued on page 233)*

vertically. There are no borders on the enlargement, which is fastened to the board with rubber cement or dry mounting tissue.

Good proportions can be obtained by mounting the photograph 2⅜" from the top of the mounting board if the picture is 11" by 14", and 3¾" if 8" by 10". The top border is the same, whether the picture is mounted vertically or horizontally. Some photographers add title and signature in pencil, making the letters about 3/16" high.

No hand-colored prints will be hung by any of the larger photographic exhibitions. The entry fee, which should be mailed under separate cover, is required to pay for handling and returning prints.

For home display, the mounting board may be hung on a small picture hook with the aid of a loop of string glued to the back. Neither string nor hook should show.



Water Colors Tint Photos

AMATEUR photographers who wish to experiment with tinting some of their pictures can do so at trifling expense by using ordinary water colors. Dissolve a little of the desired color in a tray with enough water to cover the print. Leave the print in the solution a few minutes until the required shade is obtained; then wash them with water. The color will remain.

Although this is an unorthodox way to tint photos, it gives interesting results with certain types of prints. For sunny scenes, try yellow. For pictures taken in the late afternoon, orange is appropriate. Snow scenes look realistic with a tinge of blue. Light green is fine for country scenes. A light shade of red is good for pictures taken at sundown.

Ordinary clothing dyes, obtainable at all drug and dime stores, may be used in the same way. Simply add the dye to cold water until the desired shade is obtained.

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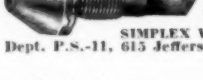

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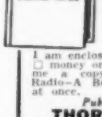

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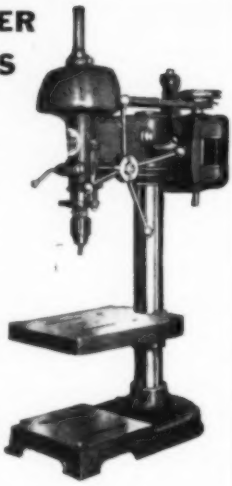

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His Vision Made Television

(Continued from page 76)

1924, at the age of eighteen, he had fully worked out the concepts of electronic television, essentially as it works today.

His father died and Farnsworth had to put aside his dreams for a while and go to work. He started a small radio shop—and, ironically, it failed. He got a job in the railroad yards.

At this point his luck changed, however. He met George Everson and Leslie Gorrell, two California business men. They listened to him for a while, and agreed to put up $8,000 and see what he could do. Farnsworth was sure his star was set now; he married a childhood sweetheart, Elma Gardner, and the couple moved to Hollywood.

Farnsworth turned the living room of his home into a laboratory. At one time the neighbors got suspicious of the strange young man and the packages he was carrying into his home and the sound of motors operating inside. This was during prohibition, and they were sure he was operating a still. They notified the police and the place was raided. The inventor, eyes blinking, finally convinced the police no liquor was being manufactured on the premises.

Money frequently ran low, and between problems Farnsworth had to beg his backers for more. In 1927 he had something to show for his work—his first patent, the one on the whole system of electronic television.

At one of the early demonstrations Farnsworth was asked by a banker whether he "saw any dollars in that pickup tube yet." Farnsworth answered by televising a dollar sign painted on a sheet of glass. The banker laughed and coughed up more money.

In 1928 Farnsworth gave a demonstration for the press in San Francisco and drew international attention to himself. Three years later he entered into an agreement with a large radio-set manufacturer, under which his research staff and much of his equipment were moved to Philadelphia.

At the end of that period he established his own laboratory there and carried on research until 1939. Then the plants were moved to Fort Wayne, Ind.

Farnsworth is the father of two boys, Philo, Jr., ten, and Russell Seymour, four. They live near Fort Wayne. Music is the chief interest in their home and Farnsworth has started to study counterpoint and theory.

He is a heavy cigarette smoker and a big-time eater. He is a good shot and a fanatic at auto driving. He races his car up and down the countryside when stumped at the plant. © *New York World-Telegram.*

The Facts About FM

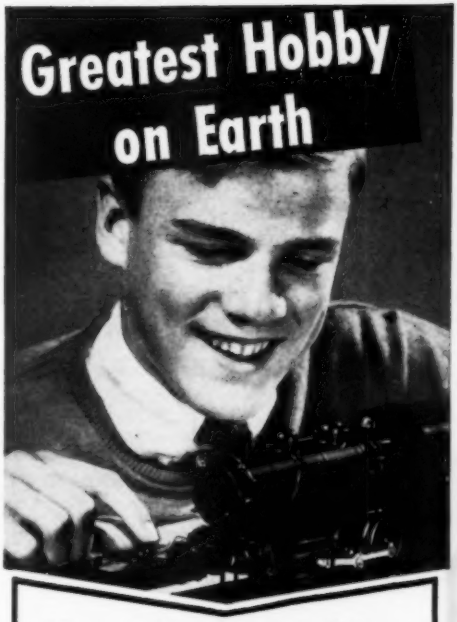
(Continued from page 72)

that annoyance? Yes. As long as the station you want to hear comes in twice as strong as any other station on the same or near-by wave lengths, you hear only the station of your choice; the others will be blocked out completely. With AM, one station must be from twenty to fifty times stronger than another before it gains the upper hand.

◆ *But suppose an FM receiver was located halfway between two FM transmitters broadcasting on exactly the same frequency? Which would you hear?* Another General Electric test will answer this query. FM signals were broadcast on exactly the same frequency by two transmitters, one in Albany, N.Y., and the other in Schenectady, N.Y., about fifteen miles away. An FM radio was installed in an automobile, and the car driven between the two cities. In Albany and for about half the distance to Schenectady, only the Albany transmitter could be heard. Halfway between the two cities, first one and then the other station would come in, depending on the contour of the ground over which the automobile was passing. But either station could be heard in this halfway zone when a directional antenna was employed. As the car proceeded toward Schenectady, only the transmitter there could be heard. At no time during the entire run did the transmitters interfere.

◆ *Without getting technical, just what is the difference between FM and AM?* To answer that without wallowing hip deep in technicalities is practically impossible, even if you are one of the few radio owners who understand exactly how their sets function. But with amplitude modulation, the signal is broadcast on a constant, unvarying wave length, with the sound modulations being accomplished by varying the power, or amplitude. With FM, the reverse is true: The power is constant, and the modulation is accomplished by varying the wave length, or frequency, within a narrow limit.

◆ *Will FM be used only for regular broadcasting?* No, it has revolutionary possibilities in the fields of police, aviation, and military radio as well. The Chicago Police Department, after a series of tests with two patrol cars cruising side by side, one equipped with an AM set and the other with an FM, plans to install FM equipment in 200 police cars. The U. S. Army and Navy also have been experimenting with FM.



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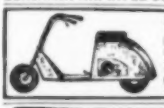

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Bombers Beware!

(Continued from page 63)

fighting forces. We still are short on quantity, but our gunners, guns, fire-control instruments, and searchlights are as good as the best any nation can offer.

For defense against high-altitude major-bombardment aviation the 105-millimeter antiaircraft gun is our most effective weapon. It can deliver rapid and accurate fire to an altitude of over five miles at a horizontal range of four miles. But the "105" is a fixed gun, so its use is restricted to certain strategically important locations.

At present the three-inch antiaircraft gun, which is effective against planes flying well over three miles up, is the most powerful mobile sky weapon we have in anything like quantity. A new ninety-millimeter gun now is considered standard equipment, although its issue is just beginning. It is effective at higher altitudes than the three-inch gun, and the burst of its heavier shell creates a larger danger space.

The snappy little thirty-seven-millimeter antiaircraft guns, which fire 120 1½-pound explosive shells a minute, have proved their worth for use against planes flying below 10,000 feet, and the .50 caliber machine gun remains a decidedly effective weapon against daring hedge-hoppers.

We now have seven antiaircraft artillery regiments in the Regular Army, and eleven in the National Guard. At least twenty more regiments will be organized as soon as equipment for them becomes available.

Balloon barrages have become familiar ornaments of European wartime landscapes. Officers of the Air Defense Command are convinced that, coördinated with pursuit aviation and antiaircraft artillery, they would be a valuable addition to our air-defense system.

No matter how efficient air-defense methods may be, some planes are sure to break or sneak through, and the bombs they drop are certain to do damage. To keep that damage to the minimum, to care for the injured, and to prevent unavoidable confusion from deepening into panic, police and civilian volunteers must be trained to perform special air-raid duties. This highly important part of air defense has not been neglected. Detailed instructions for air-raid workers have been worked out, and soon will be printed and sent to municipal governments for issue if the need arises.

Everyone hopes that we'll never see or hear enemy planes over America—but the Air Defense Command is determined that if they ever come over we'll be ready for them!

Speed Is His Business

(Continued from page 152)

ments of drama have been provided by Wilbur Shaw. There was the time when his car hit an oil slick and shot sidewise almost the full length of the straightaway while he wrestled with the wheel to prevent a spin. There was the heartbreaking climax of another speed battle when he was streaking along well in the lead and a throttle connection snapped. Then, there was the fireworks of 1931. Out of control at high speed, Shaw's car hurled itself over the concrete wall, landed upright, and slithered to a stop. Unscratched, he climbed out and finished the race in a teammate's machine.

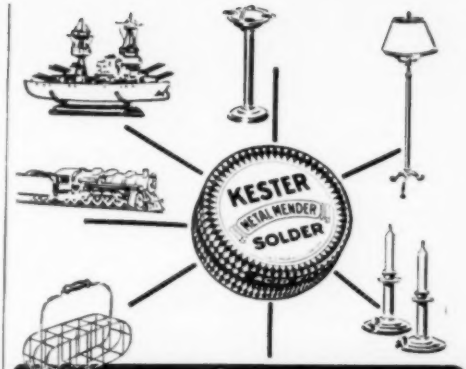
Each year, people from all over the United States send Shaw good-luck charms to carry during the race. This spring, one woman forwarded a buckeye and reported she had won seven international contests since she had been carrying the luck-bringing nut. From Long Island, a druggist sent a tiny wooden man, labeled "Ptomaine Tommy." He wrote that the figure was so lucky it was "good for anything but money at the bank." Just before he went to the starting line, last Memorial Day, Shaw looked under the seat cushion of his 350-horsepower, $20,000 Maserati and found what looked like the nest of a pack rat. There were lucky pennies, miniature horseshoes, rabbits' feet, old washers, and buckeyes. A superstitious mechanic in the pit was taking no chances. He had collected all the lucky charms he could get and had hidden them in the car!

Most drivers are as superstitious as crap shooters. Shaw is pretty much of an exception. He is the only driver, for instance, who will let a woman have her picture taken sitting at the wheel of his machine—a thing that sends chills down the back of the average driver. The lucky charm Shaw relies on most is careful preparation. With him, driving is a business and a specialized science. He practices every track maneuver until it becomes instinctive. He helps tune up his car to as near mechanical perfection as possible. He was the first driver in America to wear the common-sense crash helmet which has since become conventional.

"In racing," he explained, "you don't have to have good luck. But you mustn't have bad luck!"

His skill and preparations take care of his good luck and a pair of half-hearted superstitions ward off the bad. One of these is his lucky racing shoes, a nondescript pair of leather sneakers he has worn in every

(Continued on page 240)



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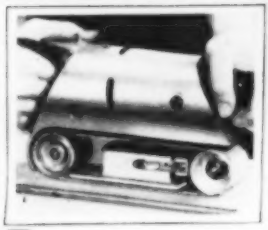

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Speed Is His Business

(Continued from page 239)

race for fifteen years. The other is his taboo against peanuts in the pit. Years ago, a Swedish mechanic named Olsen warned him that peanuts in the pit meant bad luck on the track. Shaw scoffed at the idea until, at a race in California, he saw a spectator, munching peanuts, lean over the edge of the pit to ask a question. Five minutes later, he cracked up in the worst wreck of his career. There might be no connection between peanuts and crashes, he decided, but he wouldn't take chances. Henceforth, peanut munchers became taboo around the Shaw pit.

After every victory, Shaw receives a deluge of mail. His sudden wealth is a magnet that draws letters from a thousand and one stock salesmen, real-estate operators, charity leaders, and impoverished inventors. People with dude ranches for sale, people with mortgages that are going to be foreclosed, people who are sick, people who have bright ideas and get-rich-quick schemes, all sit down with pen in hand to write to Wilbur Shaw.

The queerest of all these communications came in only a few weeks ago. It was written by an elderly inventor. He desired backing for a revolutionary idea that would simplify farming. It was a machine so long that the front end would plant the crop, the middle part would cultivate it, and the rear end would harvest it!

Today, Shaw's private stable of high-speed vehicles includes an airplane he flies himself, an imported motor cycle, and three automobiles—one of them a specially built roadster said to be the fastest private car in the world. At the end of his racing rainbow, Shaw has found not only a pot of gold but all the speed machines he dreamed of having as a boy.

Novel Horizontal Billboard Read by Plane Passengers

GIANT "lying-down" billboards, intended to be read by airplane passengers, may be an important new development in outdoor advertising. What is said to be the first display of this kind has been erected near the Chicago, Ill., airport, on the roof of a plant manufacturing surgical dressings. Built of neon tubing, the horizontal billboard displays the firm's trade mark in a figure twenty feet across. The sign is seen by hundreds of arriving and departing plane passengers every day.

Gus and Joe Go to the Show

(Continued from page 140)

have a blow-out, and they're said to make a flat tire ride as though it still had ten pounds of air," Gus declared.

"Say! We can't afford to miss these Hudsons," he added. "Look at the Six and the Six Traveler—116-inch wheelbases, engines which have been upped to ninety-two horsepower by increasing their compression, Symphonic Styling which assures the ladies a harmony of exterior and interior colors, and don't forget that goes for the low-price group! Then there are the Super-Sixes and Commodores—larger and more expensive. Lots of improvements on all of them—a cowl ventilator which you can leave open during the heaviest rain storm; larger brake drums; and a new clutch-pedal mechanism which requires only three quarters as much effort to operate as the old one did."

Gus pulled out his watch. "Holy Moses!" he exclaimed. "Only a half hour to closing time, and you haven't even seen the new Buicks!"

Wide, low bodies, dashingly streamline, were the Buick features which first caught Henry's eye.

"Yes, they look good," Gus agreed with him. "But there are a lot of just as important improvements which don't show on the outside. Increased power, for one. One of the reasons for that increase is an improved bearing—it took the Buick engineers five years to develop exactly what they wanted, but they've got it now. Then there's compound dual carburetion. That's something brand new. It costs a little extra on the Series 40 engines, but is standard on the larger ones. By using *two* dual—double-barrel—carburetors instead of one, better mixture ratios of air to gasoline are fed to the engine, power is increased, acceleration and hill-climbing improved, and fuel consumption cut down. Another new feature is the method of forcing fresh air to the carburetors with an air scoop set up in the radiator grille. The air is piped to the air cleaner above the carburetors and it's actually under pressure from the car's forward motion!

"There's another thing. To squeeze the most power out of the gasoline, they've redesigned the piston heads so the mixture in each cylinder is compressed into a tiny ball right around the spark plug. When the spark ignites it, they get the maximum pick-up and power from the explosion, with-

(Continued on page 242)

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Gus and Joe Go to the Show

(Continued from page 241)

out any ping or detonation—knock to you.

"Say, here's something," Gus broke off suddenly, to the relief of Miller whose brain was beginning to knock a little itself under the high compression of Gus's explanations. "The 'Buick Bug!' Famous old racing car! Brother, do I remember back in 1910 when Louis Chevrolet was busting speed records right and left with it! Look at that radiator—behind the motor. Just a bunch of curved pipes with fins on them. It didn't even have a fan then. Notice that Buick had overhead valves then—and has stuck to them ever since."

"Like Chevrolet," interrupted Miller. "They still have overhead-type valves, too, haven't they?"

"Right," answered Gus.

Passing the Chevrolet display again, Gus remarked: "They've redesigned the combustion chamber this year so the new Chevrolets will turn up ninety horsepower instead of eighty-five. And the wheelbase is increased to 116 inches to give you a steadier, smoother ride. . . ."

"Yoo-hoo! Henry! Mr. Wilson!" Mrs. Miller's voice was calling from across the aisle.

They went over to her and Joe, feeling properly ashamed of themselves for having played truant for so long. But Mrs. Miller didn't seem to care, and Joe Clark was looking both self-satisfied and faintly embarrassed.

"I've decided which car we want, Henry," Mrs. Miller told her husband. "Mr. Clark advised me about it, so you needn't worry. The salesman is going to bring it out for you to see next Sunday morning. And what do you think Mr. Clark has done?"

Gus looked hard at his partner, and Joe got red in the face.

"He's either robbed a bank and got away with it, or he's bought a new car," Gus said.

"Well, my old bus is worn out—you said so yourself," Joe defended himself rather sheepishly. "I'll bet you bought one yourself—it was you who wanted to come to the show."

"I didn't buy anything except my ticket to get in," Gus said cheerfully. "I like all these new gas-buggies too much to settle down to any one of them!"

"Isn't that just like a man?" Mrs. Miller demanded. Then she giggled. "Mr. Wilson, I'll just bet that you felt the same way about girls, and that's why you never got married!"

Testing Your 1941 Car

(Continued from page 135)

out the assembled cars at the proving grounds. How much water will spurt up through cracks and slots in the floor? What will happen when the brake bands get wet? Can the ignition system and the carburetor take a ducking without stalling the car? A thirty-mile-an-hour splash through the "bathtub," a street-wide trough of water, settles these questions.

Driving in circles of ever-narrowing diameter provides a novel test for a car's stability in turning corners. It also compares the merits of various nonskid tires. At a 108-foot radius, the motor strains and tires scream as the test driver holds the accelerator down to the floorboard. A passenger has to cling to the door handle to keep from sliding across the seat. Yet the speedometer registers only thirty-two miles an hour. According to General Motors men who devised the test, that is about as fast as any car will go in such a small circle, because of the power used up in forcing the car to turn.

Another odd test shoots an artificial hurricane at the side of the car, so that the amount it swerves can be measured. At the Ford proving grounds, the blast is provided by a four-bladed, fourteen-foot propeller, driven by a 750-horsepower engine and mounted so that it can be aimed either broadside or diagonally to create crosswinds.

How important car makers consider this intensive testing may be judged from the fact that, in the up-to-date Chrysler engineering laboratories, as many as 2,500 different research projects may be found under way at once. Current experiments range from testing the life of seat cushions, with a metal form nicknamed the "lead fanny," to heat-treating parts with radio waves.

For the latter purpose, the engineers have designed an electrical device resembling the "artificial fever" or diathermy apparatus used in hospitals. Placed in a high-frequency coil without touching it, a gear or other metal part is heated by induction *from the inside out*, attaining a high temperature in a split second. Valuable experimental data may thus be quickly obtained, for nearly all of a car's mechanical parts owe their hardness or softness to heat-treating.

Perhaps, in the future, this kind of electric heat treatment may actually become commercial practice. It would not be the first time that car research men have pioneered an outstanding advance. Always they are working on two jobs at once—planning for the current year's models, and for the car that may come some day.

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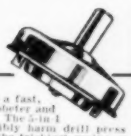

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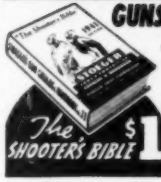

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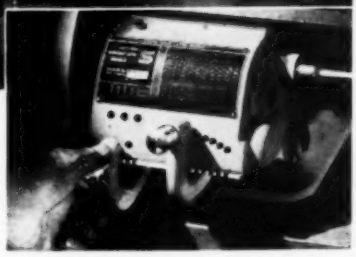

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